THE JOHN CRERAR
MAY 14 1937
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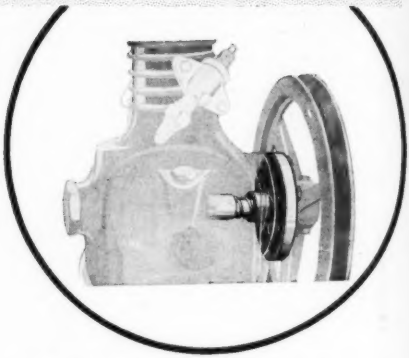
VOL. 5
NO. 5

MAY · 1937

THE TIME IS HERE

Get Ready for



Rotary Seal is fully protected by letters patent.

SHAFT LEAKS—USE ROTARY SEAL

● ***The best refrigeration replacement unit ever presented to the refrigeration engineer.***

You can be TOPS SERVICE MAN in your community with ROTARY SEAL. Easy to install—absolutely dependable—SATISFACTION GUARANTEED. Built to high precision standards. ROTARY SEAL sells on PERFORMANCE. Positively stops shaft leaks—and does it in a most simple manner. No lost time—no special machining, drilling, lapping.

You can do more jobs in one day with the ROTARY SEAL UNIT and do them right—you can make more money with ROTARY SEAL—the most simple, positive refrigeration shaft seal on the market.

Your nearest jobber can supply you quickly with 73 different units. Stock up now and get that profitable summer business.

ROTARY SEAL COMPANY
805 W. MADISON STREET, CHICAGO

INSTALL* ROTARY SEAL *REPLACEMENT UNIT

ZENITH REFRIGERANT FILTERS

THE FOLLOWING
PROMINENT JOBBERS
HAVE ZENITH
FILTERS IN STOCK

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Atlanta, Georgia	Leo S. Bosarge Company
Atlantic City, New Jersey	Refrigeration Equipment Company
Baltimore, Maryland	Melchoir, Armstrong, Dessau Company
Binghamton, New York	Service Supply Company
Boston, Massachusetts	Rhode Island Supply & Eng. Company
Brooklyn, New York	Coleman Electrical Supply Company
Brooklyn, New York	Melchoir, Armstrong, Dessau Company
Buffalo, New York	Root, Neal & Company
Cambridge, Massachusetts	Melchoir, Armstrong, Dessau Co.
Charlotte, North Carolina	Henry V. Dick & Company
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Chicago, Illinois	Automatic Heating & Cooling Supply Co.
Chicago, Illinois	H. W. Blythe Company
Chicago, Illinois	Borg Warner Service Parts Company
Chicago, Illinois	H. Channon Company
Chicago, Illinois	W. W. Grainger Company, Incorporated
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Cincinnati, Ohio	Williams & Company, Incorporated
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Cleveland, Ohio	Debes & Company
Cleveland, Ohio	Williams & Company, Inc.
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Detroit, Michigan	J. M. Oberc, Incorporated
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Greensboro, North Carolina	Home Appliance Service Co., Inc.
Harrisburg, Pennsylvania	Melchoir, Armstrong, Dessau Co.
Harrisburg, Pennsylvania	Refrigeration Supply Company
Harrison, New Jersey	Refrigeration Equipment Company
Hartford, Connecticut	Melchoir, Armstrong, Dessau Company
Houston, Texas	Walter Refrigeration Supply Company
Indianapolis, Indiana	Duncan Supply Company
Indianapolis, Indiana	F. H. Langsenkamp Company
Kansas City, Missouri	Forslund Pump & Machinery Company
Long Island, Hempstead, New York	Sid Harvey, Incorporated
Long Island, Jamaica, New York	Sid Harvey, Incorporated
Los Angeles, California	Refrigeration Service Incorporated
Los Angeles, California	Refrigeration Supplies Distributor
Louisville, Kentucky	S. W. H. Supply Company
Minneapolis, Minnesota	Refrigeration & Industrial Supply Co.
Mt. Kisco, New York	County Seat Plumbing Supply Company
Newark, New Jersey	T. W. Binder Company
Newark, New Jersey	Melchoir, Armstrong, Dessau Company
New Orleans, Louisiana	Enocha Sales Company
New York, New York	Aetna Supply Company
New York, New York	The Harry Alter Company
New York, New York	Federal Refrigerator Corp.
New York, New York	Melchoir, Armstrong, Dessau Company
New York, New York	Paramount Electrical Supply Co., Inc.
New York, New York	Servicemen Supply Company
Omaha, Nebraska	H. C. Noll Company
Paterson, New Jersey	White & Shauger, Incorporated
Philadelphia, Pennsylvania	Melchoir, Armstrong, Dessau Co.
Pittsburgh, Pennsylvania	Oakland Refrigeration Supply
Pittsburgh, Pennsylvania	William M. Orr Company
Pittsburgh, Pennsylvania	Williams & Company, Inc.
Providence, Rhode Island	Rhode Island Supply & Eng. Co.
Richmond, Virginia	Refrigeration Supply Company
Richmond, Virginia	A. B. Tiller, Incorporated
Rochester, New York	Melchoir, Armstrong, Dessau Company
Rochester, New York	Ontario Metal Supply Company
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Shreveport, Louisiana	Interstate Electric Company
Sioux City, Iowa	Refrigeration Supply Company
Springfield, Massachusetts	C. P. Payson Company
Washington, D. C.	Melchoir, Armstrong, Dessau Company
White Plains, New York	County Seat Plumbing Supply Co.
Wilkes-Barre, Pennsylvania	Radio Service Company
Montreal, Canada	Modern Household Appliances, Ltd.
Montreal, Canada	Railway & Eng. Specialties Ltd.
Toronto, Canada	Railway & Eng. Specialties Ltd.
Winnipeg, Canada	Railway & Eng. Specialties Ltd.

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New York, New York	Melchoir Armstrong, Dessau Co.

BECAUSE

Zenith elements provide finer spacings (.002") than any asbestos sack or wire screen filter.

Two and one-half times finer than 120 mesh screen.

Easily installed

Easily cleaned

Permanent Protection

Corrosion proof—Leak proof

Ample capacity

For Sulphur Dioxide, Freon or Methyl Chloride Refrigerators

Positive Protection against dirt in Expansion Valves, Solenoid Valves, Float Valves, Capillary Tubes and other liquid control devices.

ZENITH CARBURETOR COMPANY

SUBSIDIARY

BENDIX AVIATION CORP.

DETROIT, MICHIGAN

ANACONDA

ANACONDA COPPER REFRIGERATOR TUBES

MAKE the success of your installation jobs *more certain* by using these tubes from "copper headquarters". More than a century of manufacturing experience is behind the name "Anaconda".

The precision methods of The American Brass Company give these tubes the uniformity necessary for efficient installation. Each and every length of tube has the same *unusually bright, clean inside surface.* Manufactured according to A. S. T. M. specification B68-33.

Deoxidized. These quality tubes are 99.9% pure copper, deoxidized to increase corrosion-resistance and improve physical properties.

Unusually soft. Anaconda Copper RefrigerationTubes are easy to bend and may be *flared without cracking.*

Anaconda Copper Refrigeration Tubes meet the leading refrigerator manufacturers' specifications in every way. They are carried in stock by distributors of refrigerator parts.

IT4T4

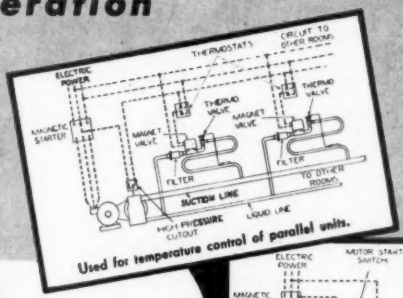
FRENCH SMALL TUBE *Branch*

THE AMERICAN BRASS COMPANY · General Offices: Waterbury, Conn.

Offices and Agencies in Principal Cities. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario

Announcing the New TYPE M125 MAGNETIC STOP VALVE

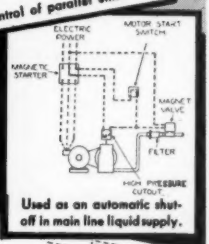
For Air Conditioning and Refrigeration



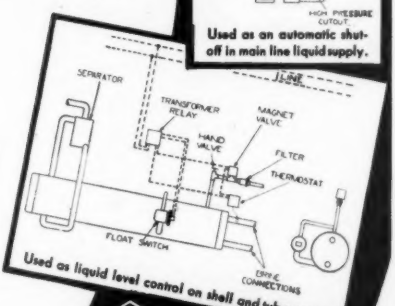
Used for temperature control of parallel units.

ALCO ENGINEERED

● *Possible applications of the new M125 magnetic stop valve.*



Used as an automatic shut-off in main line liquid supply.



Used as liquid level control on shell and tube cooler.

- Sturdy Construction
- Packless Tight Seating
- Power Consumption—13 Watts
- Capacity—5 Ton Freon, 10 Ton Methyl Chloride, at 3 lb. P.D.
- Parts Exposed to Flow are Forged Brass and Stainless Steel
- Can be used for Refrigerants—Brine—Oil—Water or Air
- For Alternating or Direct Current

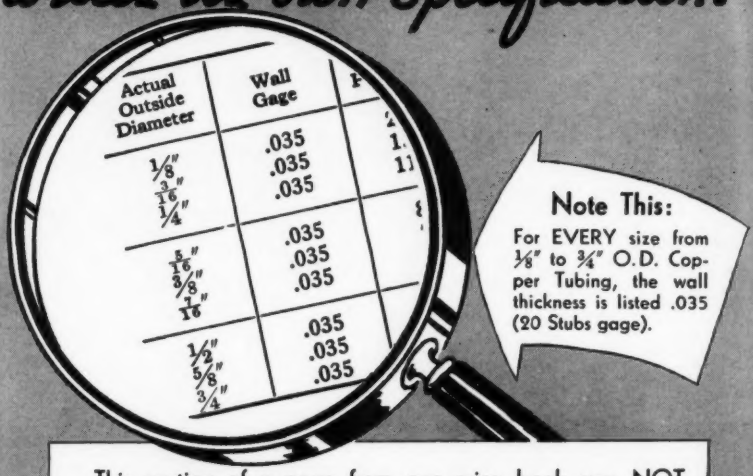
For Complete Information ask for Bulletin No. 158

ALCO

ALCO VALVE CO., INC.

2630 Big Bend Blvd. ST. LOUIS, MO.

DOMESTIC REFRIGERATION *writes its own Specification!*



This portion of a page from *our* price book was NOT written by us. It was written by some of the most important manufacturers of Domestic Refrigeration and by their installation and service men.

Copper tubing with thinner walls cannot pass the codes of most cities; nor is it considered adequate by these leading manufacturers.

Demand Wolverine Copper Tubing. It is stamped at regular intervals with a small "W". This mark tells you it's genuine Wolverine Deoxidized, Dehydrated, Copper Refrigeration Tubing with:

FULL wall thickness—to A.S.T.M. Specifications B68-33.
Made from 99.9% electrolytic copper by approved methods.
Made uniformly soft for easy cutting, flaring, and bending.
Made mirror-clean, bright annealed. Thoroughly deoxidized, dehydrated, and solder sealed.

ASK YOUR JOBBER

He will show you the small "W" stamped at regular intervals on the tubing—Your guarantee that Wolverine Copper Tubing is the RIGHT tubing for the job.

WOLVERINE TUBE COMPANY

1411 CENTRAL, DETROIT Sales offices in major cities

Jobbers with Local Stocks

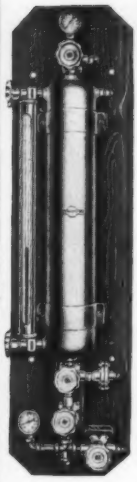
Albany, N. Y. — Hoy & Co.
Allentown, Pa. — General Refrigeration Supply Co.
Atlanta, Ga. — J. M. Tull Metal & Supply Co., Inc.
Baltimore, Md. — Clendenin Bros., Inc.
Baltimore, Md. — Melchior, Armstrong, Dessau Co.
Binghamton, N. Y. — Service Supply Co.
Boston, Mass. — A. E. Borden Co.
Bridgeport, Conn. — Parsons Bros.
Brooklyn, N.Y. — Coleman Electrical Supply Co., Inc.
Brooklyn, N.Y. — Melchior, Armstrong, Dessau Co.
Buffalo, N.Y. — Root, Neal & Co.
Cambridge, Mass. — Melchior, Armstrong, Dessau Co.
Charlotte, N. C. — Henry V. Dick Co.
Chicago, Ill. — H. W. Blythe Co.
Chicago, Ill. — Max A. R. Matthews
Chicago, Ill. — Borg-Warner Service Parts Co.
Chicago, Ill. — Refrigeration Equip. & Supply Co.
Chicago, Ill. — Fred C. Kramer Co.
Chicago, Ill. — H. Channon Co.
Chicago, Ill., Automatic Heating & Cooling supply Co.
Cincinnati, Ohio — The Merkel Bros. Co.
Cincinnati, Ohio — Williams & Co., Inc.
Cleveland, Ohio — Williams & Co., Inc.
Columbus, Ohio — The Justus & Parker Co.
Dallas, Texas — The Electromotive Co.
Davenport, Iowa — Republic Electric Co.
Dayton, Ohio — The W. H. Kiefaber Co.
Denver, Colo. — Auto Equipment Co.
Detroit, Mich. — J. M. Operc, Inc.
Detroit, Mich. — Borg-Warner service Parts Co.
El Paso, Texas — Zork Hardware Co.
Fargo, N. D. — Fargo Foundry Co.
Flint, Mich. — Shand Radio Specialties
Fort Wayne, Ind. — H. J. Schroeder Co.
Ft. Worth, Tex. — McKinley Refrigeration Supply Co.
Greensboro, N. C. — Home Appliance Service Co.
Harrisburg, Pa. — Melchior, Armstrong, Dessau Co.
Hartford, Conn. — Melchior, Armstrong, Dessau Co.
Hempstead, Long Island, N.Y. — bid Harvey, Inc.
Honolulu, T. H. — Theo. H. Davies & Co., Ltd.
Houston, Texas — D. C. Lingo Co.
Houston, Texas — Walter Refrigeration Supply Co.
Indianapolis, Ind. — F. H. Lengsenkamp Co.
Jackson, Miss. — Knoths Sales Co.
Jacksonville, Fla. — Jamita Company
Kansas City, Mo., Forslund Pump & Machinery Co.
La Crosse, Wis. — W. A. Roosevelt Co.
London, Ont., Canada — Refrigeration Supplies Co., Ltd.
Long Beach, Calif. — L. B. Marsh
Los Angeles, Calif. — Refrigeration Service, Inc.
Macon, Ga. — Lowe Electric Co.
Madison, Wis. — Gustav W. Larson Co.
Memphis, Tenn. — United Refrigerator Supply Co.
Miami, Fla. — Bailey-Miami, Inc.
Milwaukee, Wis. — Chase Brass & Copper Co., Inc.
Milwaukee, Wis. — Refrigeration Specialty Co.
Minneapolis, Minn., Chase Brass & Copper Co., Inc.
Minneapolis, Minn. — Refrigeration & Industrial Supply Co., Inc.
Montreal, Quebec, Canada — Railway & Engineering Specialties, Ltd.
Newark, N. J. — T. W. Binder Co.
New Orleans, La. — Knoths Sales Co.
New Orleans, La. — The Spangler Co.
New York, N. Y. — Aetna Supply Co.
New York, N. Y. — Melchior, Armstrong, Dessau Co., Inc.
New York, N. Y. — Paramount Electrical Supply Co.
Norfolk, Va. — Noland Co., Inc.
Oakland, Calif. — Pacific Tool & Supply Co.
Oklahoma City, Okla. — Mideke Supply Co.
Omaha, Nebraska — United Supply Co.
Peoria, Ill. — Wilkins Pipe & Supply Co.
Pittsburgh, Pa. — Williams & Co., Inc.
Philadelphia, Pa. — Melchior, Armstrong, Dessau Co., Inc.
Portland, Ore. — Bill Herber, 526 S. E. Wash.
Providence, R. I. — Rhode Island Supply & Eng. Co.
Rochester, N. Y. — Ontario Metal Supply, Inc.
Rochester, N. Y. — Melchior, Armstrong, Dessau Co., Inc.
St. Joseph, Mo. — Bristol Supply Co.
St. Louis, Mo. — The Spangler Co.
Salt Lake City, Utah — Peerless Utah Co.
San Antonio, Texas — Straus-Frank Co.
San Francisco, Calif. — California Refrigerator Co.
Sacramento, Calif. — J. N. Blair Co.
San Juan, Puerto Rico — Refrigeration Supply Co.
Seattle, Wash. — Refrigerative Supply, Inc.
Sioux City, Iowa — National Refrigeration Service
South Bend, Ind. — The South Bend Supply Co.
Springfield, Ill. — United States Electric Co.
Springfield, Mass. — C. P. Payson Co.
Syracuse, N. Y. — Syracuse Equipment Corporation
Toledo, Ohio — The Heat & Power Engineering Co.
Toronto, Ont., Canada — Railway & Engineering Specialties, Ltd.
Tulsa, Okla. — Machine Tool & Supply Co.
Vancouver, B. C., Canada — Fleck Bros., Ltd.
Washington, D. C. — Refrigeration Supply Co.
Waterloo, Iowa — Winterbottom Supply Co.
White Plains, N. Y. — County Seat Plumbing Supply Co., Inc.
Wilkes Barre, Pa. — Radio Service Co.
Winnipeg, Manitoba, Canada — Railway & Engineering Specialties, Ltd.
Worcester, Mass. — Standard Supply Co.

Factory Representatives

Atlanta, Ga. — W. A. Siegfried
Chicago, Ill. — G. C. Taylor
Dallas, Texas — C. E. Boren
Dayton, Ohio — E. J. Kimm
Denver, Colo. — R. L. Chambers
Detroit, Mich. — T. F. Wilson
Los Angeles, Calif. — Van D. Clothier
New York, N. Y. — K. M. Newcum
San Francisco, Calif. — A. W. V. Johnson
St. Louis, Mo. — G. R. Postlewait
Omaha, Neb. — Austin Jones

General Export Representatives

Melchior, Armstrong, Dessau Co., Inc.
300 Fourth Ave.
New York City, N.Y., U.S.A.



SAVE TIME...LABOR... EXPENSIVE REFRIGERANT WITH THE NEW KEROTEST REFRIGERANT CHARGING STANDS

No refrigeration service shop is really complete without the efficient services of the Kerotest Refrigerant Charging Stand. One filling of this unique Charging Stand permits you to charge a number of refrigeration units or service drums in a minimum of time and lost motion. Moreover, it is unnecessary to weigh and reweigh small service drums during filling to ascertain weight of refrigerant contained therein.

As the whole unit is furnished complete, securely mounted on an oak stained panel board, not over 5 minutes set-up time is required to install the unit in your plant. Absolute safety is assured by an automatic spring loaded safety device set to release at approximately 375 lbs. pressure which may be tubed to the open air.

These Charging Stands are available in two sizes—Type 470 having a liquid capacity of 11½ lbs. Sulphur Dioxide and the new Type 471 having a capacity of 36½ lbs.—large enough to receive the entire contents of a 35 lb. SO_2 drum. Ask your local jobber about the remarkable advantages of this new Kerotest unit.

KEROTEST
REGISTERED U.S. PAT. OFF.

KEROTEST MANUFACTURING CO.
PITTSBURGH, PA.

NEW HENRY Dryers, Strainers and Valves

The Advanced Design and Large Capacity Range of Henry Products are in step with the rapid Progress of Refrigeration and Air Conditioning

THE MOST COMPLETE LINE IN THE INDUSTRY

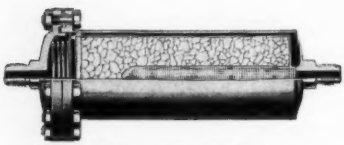
DRYERS

There is a type of Henry Dryer for every installation requirement. An exclusive feature of design is the integral liquid sight port, supplied with certain types. All but smallest sizes have dispersion tubes. Choice of 5 dehydrants AT THE SAME PRICE.

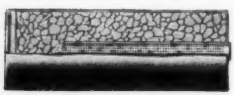
STRAINERS

Exceptionally large screen area insures maximum capacity and long service before cleaning. Negligible pressure drop. Compact design. Securely anchored screens — no bypassing of liquid. Silver-soldered fittings.

Type 733 Dehydra-Strainer

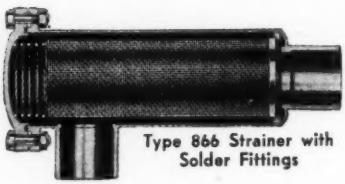


Type 744 Cartridge Dehydrator

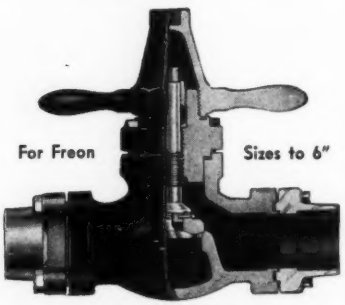


Type 74 Refill Cartridge for Type 744 Dehydrator

Type 885 Small Strainer



Type 866 Strainer with Solder Fittings



For Freon — Sizes to 6"

Wing Cap Valves

WRITE FOR NEW CATALOGS

No. 62, Dryers, Strainers, Valves and Service Tools.

No. 47, Henry Ammonia Valve and Forged Steel Catalog.

STOCKED AND RECOMMENDED BY LEADING JOBBERS

HENRY VALVE CO.

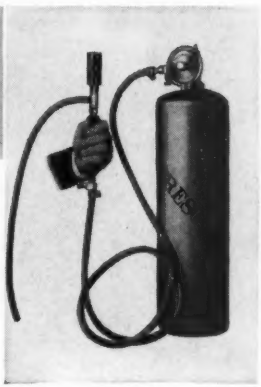
1005-17 North Spaulding Avenue · CHICAGO · ILLINOIS

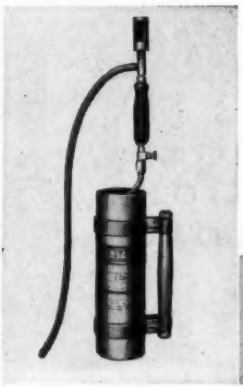
PREST-O-LITE

Trade-Mark

HALIDE LEAK DETECTOR

Prest-O-Lite Halide Leak Detector with the B tank.





Prest-O-Lite Halide Leak Detector mounted on the MC tank.

The *Prest-O-Lite* Halide Leak Detector is a positive, sensitive device for locating leaks of non-combustible halide gases in refrigerating and air-conditioning units. These gases—such as F-12 (Freon), F-21, F-114 and Carrene—are relatively odorless, tasteless and colorless, properties which render necessary a quick, sure method of locating leaks.

Ask your jobber or any Linde office for a demonstration and descriptive folder.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

New York and Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

FEATURES

1 Assures instant reaction to any concentration of refrigerant gases.

2 No preheating, pumping or priming required.

3 Economical to use. Need not be lighted until actual testing begins.

4 Two-color flame variation gives visible indication of amount of gases.

5 Quick clearing of flame after exposure to leaks.

6 Reaches easily into inaccessible places.

7 Readily portable—ideal for service work.

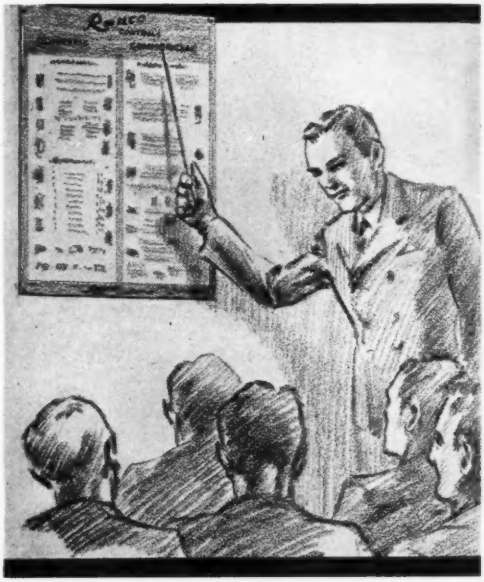
"Commercial Controls? —I'll Tell The World!"

Count on

Ranco

for

PRECISION CONTROLS of HIGHEST QUALITY



CHECK WITH YOUR RANCO JOBBER—on the outstanding new developments in Temperature and Pressure Controls for commercial service. A great new field is opening up rapidly—and Ranco is *out in front*, as always! Count on Ranco—for Commercial Controls that ably meet today's demands!

Tell us what types of applications you are especially interested in and we'll send bulletins describing Ranco's newest developments.

Ranco INC. Columbus, Ohio

The Refrigeration Service Engineer

Vol. 5 No. 5

May, 1937

A Monthly Illustrated Journal Devoted to the Interests of the Refrigeration Service Engineer in the Servicing of Domestic and Small Commercial Refrigeration Systems and Oil Burners

Official Organ
REFRIGERATION SERVICE ENGINEERS SOCIETY

COVER

This month's cover shows L. L. Vollman, Vice President St. Louis Chapter, R.S.E.S. doing some silver soldering work.

Published by
Nickerson & Collins Co.
433-435 North Waller Ave.
Chicago
Telephones Austin 1303-1304-1305

EASTERN OFFICE
149 Broadway, New York City
Telephone Barclay 7-8275

Publishers of Technical Books and Trade Journals Serving the Refrigeration Industries for 46 years.

Subscription Rates United States $2.00 per year. Single copies 25c. All other countries $3.00 per year.

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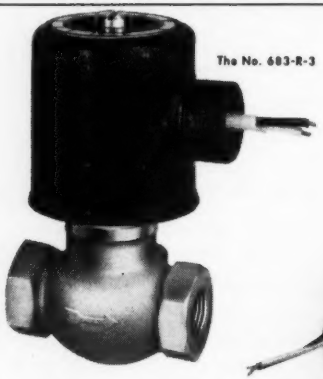
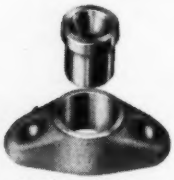
Solenoids THAT WILL NOT HUM

A most important factor in solenoid valve operation is silence – no A. C. hum. The new "Genuine Detroit" Solenoids have definitely eliminated this. • In addition, Detroit Solenoids are powerful . . . have greater lifting power and greater capacity. They operate freely. A strong kick-off spring has been incorporated to prevent sticking open after the current has been cut off. • These solenoids are also considerably more durable. Needle and seat are made of non-corrosive metal, non-magnetic and highly wear resistant. The body is made of dense homogeneous special body brass . . . the same mix used in hundreds of thousands of Detroit Expansion Valves. • Orifice sizes range from $\frac{3}{16}$" in the 683-R-3 to $\frac{5}{8}$" in the 686. • The 683-R-3 is provided with female pipe thread or with SAE fittings. The 686 is available with female pipe thread or with flange and tail pipe for sweat connection. • The new flange and tail pipe construction of the 686, Detroit Solenoid provides greater flexibility in installation than other units. The dealer can satisfy the complete range of requirements with fewer stock valves. Note the simple hook-up of the No. 686 with the No. 782 Strainer. • The standard flange and interchangeable tail pipe assembly permits any line connection simply by selecting the proper tail pipe size. These tail pipes are not only small, easy to stock, but they are inexpensive.



The No. 683-R-3



Interchangeable Flange and Tail Pipe

The No. 686 Assembled with No. 782 Strainer

DETROIT LUBRICATOR COMPANY

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Write for Descriptive Bulletin

The Refrigeration Service Engineer

VOL. 5, No. 5 CHICAGO, MAY, 1937 $2.00 Per Annum

Service Hint

Acoustical Testing

A Simple Instrument to Determine Location of Mechanical Difficulties

By GEORGE EDGAR WAYNE

THERE are many instances where the ear can be relied upon to check up on certain troubles in refrigeration apparatus. For instance, most service men are cognizant of the use of a long screwdriver held against the compressor cylinder or crankcase to ascertain looseness of parts and their location. One mechanic I know carries a thin piece of very hard wood for the purpose, which he holds between his teeth, excluding all other sounds by stopping his ears with his fingers to determine the source of noise in servicing compressors.

Comparative looseness of parts can be nicely determined by this method, such as in a twin cylinder compressor where one bearing may be loose and causing a knock.

An instrument of greater refinement and one permitting a wider range of usefulness is shown in Fig. 1. It makes use of one of the old type telephone receivers, the internal parts being removed and discarded. The diaphragm may be salvaged, although it is advocated that a replacement disc of thin copper or phosphor bronze be used in its place, the latter being the better material.

A brass tube or rod of about $\frac{3}{16}$ inch in diameter of suitable length is soldered to the exact center of the diaphragm. If a brass rod is used for the purpose it should be pointed at the probe end, but if a tube is selected a brass tip should be turned and soldered to the end, as indicated in the sketches.

In order to prevent excessive wabbling of the rod a piece of sponge rubber should be cut, pierced and fitted in the small end of the receiver shell.

For ordinary work a short rod will suffice, but for checking all jobs a probe end of some 8 or 10 inches should be used.

Uses

Motors can be checked without removal from the base. A bad bearing can be detected by a grinding or gritty sound. Striking of the poles can be readily heard if the shaft has been sprung or undue wear in the bearings has occurred. Switch action in a.-c. motors can be checked, so that sluggish action, or a weak spring, or low tension on same, can be clearly heard by the use of the acoustic device.

Compressors offer an excellent opportunity for checking by this device. Where bearings are bad or being cut the scoring sound can be definitely located. In many cases seal leaks were predicted before they actually began to lose oil and refrigerant around the shaft.

Looseness in a piston, big end of connecting rod, or a worn wrist pin, can be clearly heard and located with definiteness.

Where keys have been lost or thoughtlessly not replaced, or where set screws were not seated properly on shafts, the resulting clicking noise can immediately be picked up.

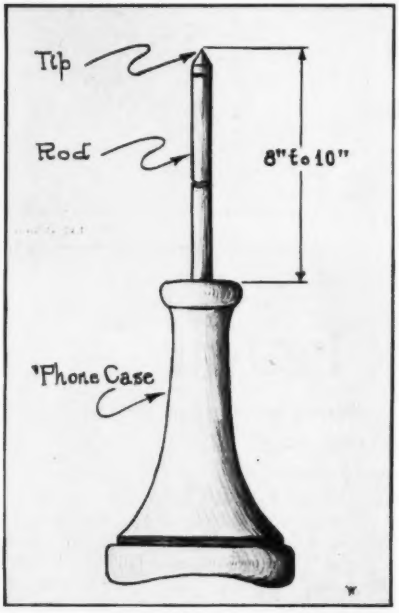


FIG. 1. TELEPHONE RECEIVER CONVERTED INTO TESTING UNIT.

An interesting use for the acoustic device is in checking the action occurring in evaporators. In the dry type the rush of gas can be distinctly heard. Oil pockets or traps in any low levels or bellies in both coils and suction lines can be definitely allocated to the zone of trouble. A thick "glugging" sound can be heard as the gas bubbles through the oil at such points.

A flooded low side offers an interesting study, a steady bubbling noise being heard under correct conditions and an intermittent gushing sound detected where oil binding has occurred. A worn, eroded or corroded needle (requiring replacement or reoperation in each case) results in a distinct hiss, interspersed with gushes of liquid.

Defective expansion valves, both the thermostatic and automatic constant pressure types, are easily checked by listening to the throttling action.

Checking Liquid Lines

Liquid lines, particularly on multiple jobs, are easily checked, especially where a stoppage must be detected in one of the feeder liquid lines which branch off the main line.

The acoustic device is simple to make and just as simple to use. While it is somewhat delicate it can be included in servicemen's kits and should be used to a greater extent in shops.

The writer has made excellent use of this type of device and mechanics will find it a definite aid in locating troubles, as previously listed.

Another Type of Instrument

A little care used in the construction of the device will repay itself in having a delicate instrument. Those who are able to obtain a doctor's old stethoscope can make use of this device despite the smiles that may attend its use. The cost of a new one is prohibitive for the use to which it would be placed, but an old one should be a welcome addition to the tool kit. The telephone case type is not complicated and can be made at slight cost. A somewhat simpler form can be made by using a piece of one-eighth inch steel rod and providing a button at one end. Those fortunate in having welding or brazing equipment can attach a metal disc at the listening end and have a simple instrument. This latter type, however, does not compare with the former ones, but will serve for rough field work.

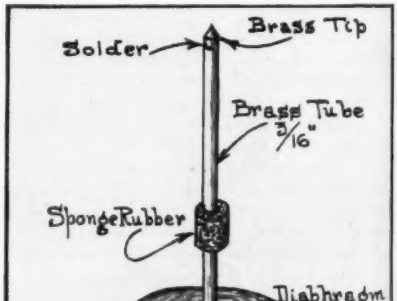


FIG. 2. DETAILS OF SIMPLIFIED CONSTRUCTION.

Domestic and Commercial Refrigerators

Insulations and Heat Loads

Data Pertaining to the Accurate Determination of Heat Loads of Household and Commercial Refrigerators

By L. K. WRIGHT, *Mem. A.S.R.E.*

Refrigerators

A REFRIGERATOR is a box-like structure equipped with one or more doors, the enclosing walls, floor and ceiling of which are filled or provided with some form of heat retarding material, known as insulation. Since the interior or storage space, together with the contents, is maintained at temperatures below the surrounding or ambient air, it follows that heat will flow from the warmer body (the air) to the cooler object (the refrigerator). To minimize this leakage or flow of heat into the box various insulation materials are employed. The function of the insulation is not to keep the cold in, but to keep the heat out and so lessen the amount of heat to be removed, so that temperatures may be kept low in the refrigerator.

Each manufacturer of refrigerators has adopted some individual or combination of insulating mediums as a standard and is inclined to consider the wall structure and particular design selected to represent the acme of perfection. As a matter of fact, there is something wrong with every insulation, from a practical, commercial point of view, for not a single one can be classed as perfect. One important point must be borne in mind concerning the refrigerator; that is, regardless of the quality of the insulation employed, the general structure must be considered, for the very finest insulation obtainable, improperly or carelessly applied, of insufficient thickness or poorly protected against infiltration of air will give poorer results over a period of time than a properly sealed and expertly applied medium of inferior insulation value.

Importance of Good Insulation

Man has known better for many centuries than to store liquids in leaky vessels. Today no one allows steam to escape from leaky pipes, nor is electric power permitted to go to waste by failure to insulate the wires in the proper manner.

But, when it comes to refrigerators, many men make no effort to obtain a good box. In fact, many consider the first cost as the only investment and purchase for least outlay, making no intelligent effort to understand that insulation is the means of preventing heat from flowing into the box and to cut down operating costs.

The reason for this neglect is obvious. Heat is a very commonplace thing and we experience its effects every hour of the day, so that we come to consider it a very commonplace thing. So common, in fact, we no longer actually think of it. The same might be said of light. So far as light is concerned we can completely shut it off through erecting a thin opaque barrier. But with heat, nothing will completely stop its passage. Of all the known forms of energy, it is one of the most powerful. The average man is not apt to reason in this manner, for he concerns himself more with the refrigerating machine. There he sees the wheels go around and can compute the number of strokes of the compressor. Work of course is being done by the machine, but through poor insulation, most of this work or running time is a pure waste.

The average man is apt to reason that anything at all is suitable to fill the walls of a refrigerator, for insulation does not show. It is covered up anyway. The fact stands, however, that despite the use of the finest, thickest insulation it is possible to buy, more than three-fourths of the heat load of the average refrigerator is that which leaks through walls, doors, windows, floors and ceilings. Approximately one-fourth of the work done by the machine is actually required to cool the stored goods. Thus, if ice is employed, seventy-five out of every one hundred pounds put into the ice bunkers will melt away in taking care of the heat which flows through the insulation. With a machine unit the same condition obtains, for three-fourths of the running time

must be devoted to the removal of heat entering the box.

Thickness of Insulation

This loss or heat leakage cannot be prevented entirely, because no material is thoroughly heatproof. It is possible, however, to reduce it to a reasonable extent, beyond which it would not be profitable to go. Refrigerators should be protected against heat infiltration to a point where the cost of additional insulation would not be offset by the extra saving in operating expense.

The better refrigerators are well insulated, while the poorer grades allow much more heat leakage, due to inferior construction and inefficient or insufficient insulation. On small household refrigerators the door or doors take up practically one entire wall. It is important, therefore, that the doors be properly insulated and so designed that they swing flatly and tightly against the sides of the box or directly into it and cover or plug the openings thoroughly. A rubber or other resilient gasketing material is used to seal the door edges so that no air leakage can occur. As the door is opened the cooled air rushes out and warm air enters. When the door is again closed the fresh, warm air becomes chilled and tends to draw in warm air if the door is not properly sealed. If there was a crevice in the insulation the air would be drawn through this point, if the door was properly gasketed and the air could not enter at that point. For this reason it is important to have a thoroughly sealed insulation as the "breathing" action will not only impose a higher load but in time will result in water-logged insulation.

Heat Leakage

A refrigerator may be likened to a ship in the ocean, for despite the best materials and care, a certain leakage is always present. If, however, openings occur because of poor construction the amount of leakage is increased above that which is normally encountered and will not result in satisfactory service.

Even the best insulation materials allow a certain quantity of heat to pass through, for none are perfect heat barriers. In fact, if there was a truly perfect insulation commercially available a refrigerator equipped with such a material would require but one-tenth the weight of ice or refrigerating effect required to keep it cool, as compared to the identical refrigerator insulated with cork, felt, wool, kapok or balsa wood.

Conductivity

As previously explained, all materials have a certain conductance value. Those of high conductance value, such as metals, are used in building engines and compressors, for they convey the heat generated by the operation of the machines to another medium, such as air or water, for dissipation, thus keeping the apparatus at a low operating temperature. Other substances of low conductivity, such as cork, wood or felt, are used as insulators or barriers to the passage of heat and are used to prevent the entrance of heat or to retain heat in certain instances, such as boilers or vats.

Taking cork as unity or basis of determining conductivity, the following materials, commonly employed in the construction of refrigerating plants and apparatus are listed with their comparative values:

RELATIVE THERMAL CONDUCTIVITY OF INSULATING MATERIALS

Cork	1.00
Wood	3.36
Water	13.00
Brine	15.00
Steel	1,073.00
Copper	8,580.00

Source of Heat

The preponderance of heat which must be removed is that which leaks through the walls of the box. This may be contrary to any previous conception involving the use of a refrigerating media in that we may have considered that the stored foods alone utilized the cooling effect. In order to prove this let us select a typical refrigerator and estimate the heat load.

Typical Household Refrigerator

In previous years designers utilized two or more doors for the small household refrigerator, but the modern trend is toward single door construction, especially the small mechanically cooled type. For the purpose of illustration, let us take an apartment house type of refrigerator, of the two-door type, making use of ice. The standard "iced" box makes use of two doors, one for the ice storage section and the other, usually larger, for the food compartment, as shown in Fig. 1. To convert such a box for mechanical refrigeration a cooling unit would be used in the ice compartment.

The following data and dimensions refer to a top icer type of refrigerator equipped with two doors—one for the ice compartment and the other for the food section:

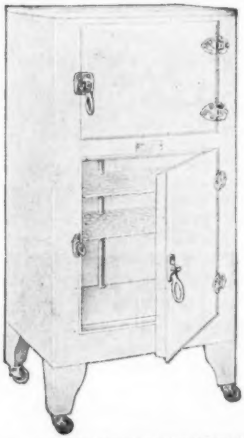


FIG. 1. A TOP ICER REFRIGERATOR

REFRIGERATION SPECIFICATIONS

	Height, Ins.	Depth, Ins.	Width, Ins.
Outside Dimensions	60	21	29
Food Compartment—inside	36	15	23
Ice Compartment—inside	16	15	23
Food Door Opening	35	..	21
Ice Door Opening	15	..	21
Volume Food Compartment	7.1 cu. ft.		
Volume Ice Compartment	3.2 cu. ft.		
Total True Inside Volume	10.7 cu. ft.		
Total Inside Surface	33.2 sq. ft.		
Total Outside Surface	50.12 sq. ft.		

From a study of the above it can be found that the walls, the top and the bottom, are apparently three inches in thickness. The food compartment would be separated from the ice section by a rack to hold the ice and a pan to catch the drip. This rack would be ignored in estimating the true interior surface or the cubic contents, but these figures are not ordinarily required and are merely presented in the specifications as a means for comparing the inside surface with the outer.

Refrigerator Surfaces

In estimating true heat leakages the square feet of exterior surface should be utilized in preference to the antiquated rule of thumb method which was based on the cubical contents or the bulk displacement. This is especially necessary with the larger commercial refrigerators. For instance, a box 6 feet wide by 10 feet long and 8 feet high, presents 60 square feet of floor surface, has a bulk displacement of 480 cubic feet and a surface area of 376 square feet. Thus, 2 ends, $6 \times 8 \times 2 = 96$; top and bottom, $6 \times 10 \times 2 = 120$; 2 sides, $10 \times 8 \times 2 = 160$; gives a total of: $96 + 120 + 160$ or 376 sq. ft.

A box of the same floor area; that is, 60 square feet, may be 15 feet long by 4 feet wide. If this box was of the same height; that is, 8 feet, it would have a cubic displacement of 480 cubic feet, the same as in the previous case, but the external surface would be greater, for it would present an area of 424 square feet. This is almost 13 per cent greater than the previous case. These comparisons are illustrated in Fig. 2.

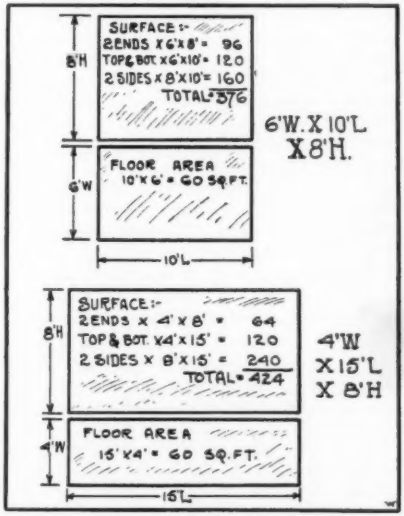


FIG. 2. COMPUTING CUBICAL AREA

Thus, though the floor areas and cubic displacements were identical in the given instances, the exterior surfaces varied. The only accurate means of computing heat leak-

age is by the use of the exterior surfaces and this method should be employed on all large or commercial refrigerators. The ratio of surface and displacement in household boxes is such that leakage or heat load may be based on either.

If the refrigerator we have selected was of the single door type, such as one intended for mechanical refrigeration, a single door opening of about 53 inches in height by 21 inches in width would be used. In either case it will be assumed that the door, or doors, are insulated in the same manner as the walls, which will be taken to be of "excellent" construction, a rating which will be explained in the following text.

Refrigerator Structures

A series of typical refrigerator wall structures are shown in Fig. 3, each being placed in one of the three groups or ratings. Those of the type which do not permit assignment to the "fair" column will not give satisfactory service, for the excessive heat leakage would cause high interior temperatures, consume too much ice, or equivalent useless operation of the mechanical unit if artificially cooled, and would not properly keep foods. The refrigerator construction should at least be such that it can be placed in the "fair" class and preferably in the "excellent" rating. The "fair" type of insulated cabinet borders too closely upon the excessive heat leakage type and if selection is possible a refrigerator of "good" or "excellent" rating should be chosen, for the slightly higher cost will soon be offset by the saving in ice, or electricity if mechanically cooled and through the maintenance of a more or less constant lower temperature, and consequently by less food spoilage.

The various wall sections shown in Fig. 3 are typical of types encountered in the field, the upper rows depicting older assemblies and the lower sketches showing the new types. The wall sections shown permit visual comparison, so that insulated walls may be assigned to the proper rating.

One would not think of installing a heating system in a poorly built, draughty barn and, by the same token, expect to obtain anything but unsatisfactory results in attempting to cool an unsound, improperly insulated refrigerator.

Insulation Ratings

Refrigerators of the household type whose walls fall into one of the three ratings; that is, "fair," "good" and "excellent," as indicated in Fig. 3, have been assigned ratings in heat leakage per 24 hours.

These ratings assume slightly larger heat transmission, greater usage factors and larger hot food storage, so that the totals are peak load conditions. A machine selected to operate a normal length of time per day and coils selected for the box on the ratings given in the table will be certain to give satisfaction under the heaviest loads.

Refrigerator Linings

Some boxes are lined with galvanized or rustless metal and left plain or coated with Duco or lacquer, while expensive ones are provided with monolithic cement or porcelain linings. We will assume the refrigerator we are interested in to be equipped with a rustless metal lining, such as nickel, nickeled copper, monel or galvanized sheet iron and with a lacquer surface. A sectional view of one of the walls of this box is illustrated in Fig. 4.

Referring to the ratings of refrigerator walls we would find such a wall structure listed as of "excellent" construction.

TOTAL HEAT LEAKAGE TABLE—B.T.U. LOAD PER 24 HOURS

Cubical Contents Cu. Ft.	FAIR INSULATION			GOOD INSULATION			EXCELLENT INSULATION		
	Temperature Belts			Temperature Belts			Temperature Belts		
	North	Central	South	North	Central	South	North	Central	South
4	7,500	9,200	10,800	5,800	7,100	8,400	4,100	5,000	5,900
5	8,100	9,900	11,700	6,300	7,600	9,000	4,500	5,400	6,300
6	9,300	11,400	13,500	7,200	8,800	10,300	5,000	6,100	7,200
7	10,100	12,400	14,700	7,800	9,500	11,300	5,500	6,600	7,800
8	11,000	13,400	16,000	8,400	10,300	12,200	5,900	7,100	8,400
10	13,700	16,600	19,700	10,800	12,970	15,200	7,500	8,300	10,600
12	15,100	18,600	21,800	11,800	14,300	16,800	8,500	10,100	11,800
14	16,600	20,500	23,900	12,800	15,600	18,400	9,200	11,000	12,900
16	18,300	22,000	26,000	14,400	16,900	20,000	9,900	11,900	13,900
19	20,600	25,100	29,700	16,000	19,400	22,800	11,500	13,700	16,000
22	23,200	31,600	33,600	17,500	21,800	25,800	12,800	15,400	19,500

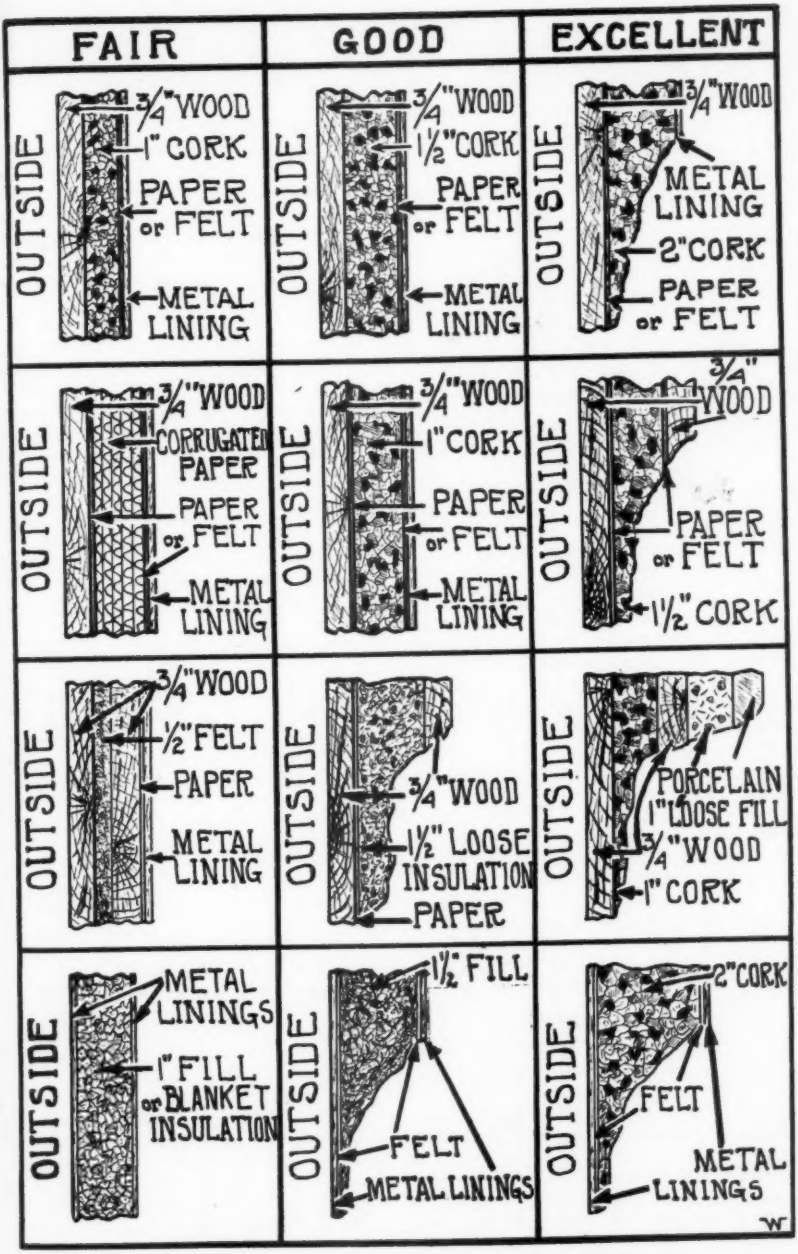


FIG. 3. TYPICAL REFRIGERATOR CONSTRUCTIONS.

Insulation

After studying the sectional view of the box one is apt to question the use of felt or paper. The reason for using these sheet materials between different insulation mediums is to prevent the infiltration of air. If the box is of wood the sections may warp and open up ever so slightly at the joints. Over a period of time the air that enters

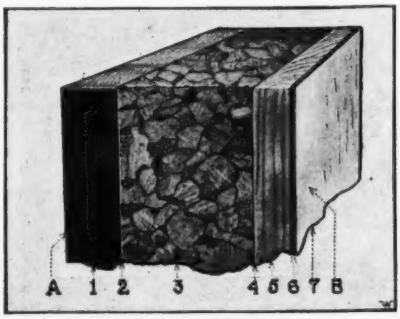


FIG. 4. SECTION OF REFRIGERATOR CONSTRUCTION WITH RUSTLESS METAL LINING.

such minute cracks will cause a diminution of insulation efficiency through the absorption of moisture. Modern household equipment is of pressed or sheet steel, eliminating much of infiltration possibilities.

The air is drawn into the cracks or crevices in two ways; firstly, due to the difference in temperature, and secondly, by virtue of the suction created every time the refrigerator door is opened and closed. Warm air will enter the crack or crevice and then become cooled. In cooling it gives up a portion of its vapor content and then sinks to the lowest point in the crevice and emerges at the bottom of the crack, warm air entering at the top to take the place of the cold air leaving. In this way a circulation is set up in larger cracks or crevices.

Deterioration of Insulation

Over a period of time enough moisture is deposited in the insulation to seriously reduce its heat resistance value. With some insulating mediums capillary attraction spreads the moisture throughout the entire wall.

Cork, felt, balsam wool, Dry-zero, kapok, balsa wood and other material applied in sheet, blanket, slab or sectional form have abutting edges to be sealed and impervious paper is used to provide an air-tight envelope. As extra precaution, two or more separate layers of insulation is sometimes employed, rather than a solid, thick block. Thick slabs are apt to crack and thus form a channel, from outside to inside, offering a direct path for air infiltration. Therefore, thinner sheets are cut and fitted into place. If the sheets are in small sections, a foot or more square, they are arranged so that no two joints are in the same line. Besides staggering the joints it is the usual practice to use paper between each layer so that each section is sealed in an individual envelope.

About 1928, metal cabinets came into general use. Sheets of metal forming the outer and inner linings are tightly crimped or sealed at the joints so that after the insulation is in place a final seal at one end assures against the entry of air for all time.

Another method in use employs slabs of insulation made up to proper size and sealed in an air-tight envelope, so that the slab may be fitted into the skeleton frame of a box to form an entire wall or section. This provides a positive seal for the insulation itself and eliminates any chance of breakdown due to infiltration of air and consequent waterlogging.

Insulation Materials

As we learned previously, each material has a certain heat conductance value. Naturally only those classed as insulators, or poor conductors, are used in constructing refrigerators. Among the insulation materials commonly employed the following may be enumerated; they are not arranged in the order of their general use:

Wood	Balsam Wool
Air Space	Aluminum Wool, sheet or crumpled
Paper, either plain, corrugated or felted	Balsa Wood
Granulated Cork	Felt
Mineral Wool	Sea Grass
Corkboard	Insulite
Dry-zero	Cocoa Fiber
Kapok	Sawdust

The better refrigerators employ a solid wall construction, made up of corkboard, balsam wool, Dry-zero, or kapok, held securely in place to prevent settling between the outer and inner linings. In the last few years metal walls have been employed, in some cases the hollow between the inner and outer shell being filled with fibrous or gran-

ulated material poured or rammed in place and then sealed with pitch or wax.

Ratings of Insulations

The first thing we must do in computing the heat leakage through the walls of the refrigerator is to make certain of its structure, and in the case of the box we are interested in, we will assume it to be composed of two wooden walls, sheet cork, three felt envelopes and a metal lining. Knowing this, let us refer to the Thermal Resistance Table and find the values of the materials referred to.

THERMAL RESISTANCE TABLE

Material	Factor
Asbestos	3.46
Balsam Wool, average	2.75
Balsa Wood, average	2.90
Calorox	4.53
Celotex	3.03
Charcoal, board	2.35
Charcoal, loose	2.75
Concrete, Masonry	0.20
Corkboard	3.29
Hair Felt	4.05
Flaxlinum	4.04
Kapok	4.21
Dry-zero	4.60
Rock Cork	3.03
Insulite	3.25
Cabot's Quilt	3.21
Mineral Wool	3.38
Paper	2.50
One Sheet of Paper	0.08
Strawboard	1.04
Wood Felt	2.75
Wool Felt	2.75
Wood	1.00
Sawdust	1.10
Stone	0.10
Linofelt	3.34
Beaver Board	1.03
Brick Wall	0.25
Cornell Board	2.00
Hollow Tile Wall	0.25

The resistance indicated for the above, except in one instance, (paper sheet) is for one square foot of the material one inch thick. Where the thickness varies from this value the resistance of the particular measure must be used, as, for instance, if a wooden lining of one-half inch was encountered the resistance value of one square foot of this material would be but .50. If, again, the wood was three-quarters of an inch in thickness the value would be .75, whereas, if it were 1 inch in thickness the thermal resistance for one square foot would be 1.00, as given in the table.

The thermal resistance values are expressed as the number of degrees (Fahrenheit) difference in temperature between two sides of one square foot of the insulation, one inch thick, necessary to force one B.t.u. through per hour. It is an easy matter to calculate the amount of heat which will pass through any insulation in 24 hours, where a temperature difference of one degree is had. This is done by dividing 1 by the resistance (R) and then multiplying by 24; thus:

$$\frac{1}{R} \times 24 = \text{Transmittance (U)}$$

Surface Resistance

Not only does the bulk of the material offer a resistance to the passage of heat, but wherever there is an air surface an additional resistance is encountered, known as Surface Resistance. This is due to a skin resistance and reflectivity, which in some insulation materials, forms the basis for the low transmission values. One of the new insulation materials dependent upon this is aluminum foil, crumpled and packed lightly into place. Other manufacturers employ the metal foil in straight sheet form, using little spacer strips to keep each sheet apart.

Surfaces normally encountered are listed below, the rating being for one square foot of surface:

SURFACE RESISTANCE

Concrete	.78
Corkboard	.73
Felt	.78
Glass	.60
Metals	.77
Paper	.78
Porcelain	.83
Wood	.73
Brick and Masonry	.73

Temperatures

Refrigerators of large size, in commercial use, vary in internal temperatures in accordance with the foods or products to be stored or cooled. It would be very important in estimating a large job to be certain of the internal temperature. With household refrigerators the temperature is usually held about 45° F. A temperature of 50° F. is sometimes used, while other boxes may be held at 40° F.

Another important factor is the outside temperature and this is usually taken as the maximum encountered in the territory. Since there is considerable latitude in the summer temperatures found in various portions of the United States, three main divisions have been selected as the best means of determining outside temperatures. In the northern division 80° is selected to represent the heat encountered, while the central section is placed at 90° and the southern group at 100° F. A map covering these divisions of temperatures is shown in Fig. 5. If uncertain as to exact location and allotted temperature check with the city records.

Calculation of Heat Load

Assuming the construction of the refrigerator to be as given in Fig. 4, we may begin the calculation of the heat load by tabulating the various resistances. Not only do we encounter bulk resistance in seven instances, as indicated in Fig. 4, by numerals, but two surface resistances (a and b) must be included.

VARIOUS RESISTANCES ENCOUNTERED IN CALCULATING HEAT LOAD

Resistance	Index	Material	Value
Surface, Outside	a	Outside Wood..	.73
		¾" Wood	.75
Wood	1	1 Sheet Paper..	.08
Paper	2	1½" Corkboard.	4.93
Corkboard	3	1 Sheet Paper..	.08
Paper	4	¾" Wood	.75
Wood	5	1 Sheet Paper..	.08
Paper	6	1 Sheet Metal...	.00
Metal	7	Inside Metal ...	.77
Surface, Inside	b	Total	8.17

The transmittance (U) may now be found by dividing 1 by the total resistance (R) and multiplying by 24, as:

$$U = \frac{1}{8.17} \times 24 = 2.95 \text{ B.t.u. per 24 hours.}$$

Assuming the refrigerator is located in the central portion of the United States, we will take the external or ambient temperature to be 90° F. The interior temperature will be taken at 50° F. Therefore, the temperature difference between the inside and outside walls is 40 degrees.

The outside surface of the box was estimated at 50.12 square feet, taken from the "Specifications."

The heat leakage may be determined from the above data, as:

U × T D × S, or:
2.95 × 40 × 50.12 = 5,914 B.t.u. per 24 hr.

Additional Loads

Besides the heat filtering through the walls, heat must be extracted from the foods stored and also from air changes, due to opening of the doors. In commercial use factors ranging from 1.2 to 2.5 are used as multipliers of the normal wall leakage load to determine these additional loads, but for household refrigerators it is of no great importance and may be ignored if desired, unless the refrigerator is to be subjected to unusual usage.

Careful tests have disclosed the fact that, for a refrigerator of the size we are experimenting with, the load, due to opening doors, is about 3%; for cooling foods 4%; while the remainder, 93%, represents the wall leakage.

The percentage allotted to the freezing of ice cubes has been eliminated, for the freezing trays vary in size and capacity. Again, one user will require a considerable number of cubes per day, whereas another may not use cubes as frequently or even at all.

Water and Ice Data

Specific heat of water = 1.00
Cooling one cubic ft. of water one degree = 62.5 B.t.u.
Cooling one gallon of water one degree = 8.33 B.t.u.
Cooling one quart of water one degree = 2.04 B.t.u.
One cubic ft. = 7.48 gallons
One cubic ft. = 30 quarts
One gallon of water = 8.33 pounds
8.33 pounds of ice = 1 gallon of water
50 pounds of ice = 6 gallons of water
One gallon of water = 231 cubic inches
Specific heat of ice = .504 (taken as .5)

Load

The usage load, due to the opening doors would be about 180 B.t.u. (3% of load) while the food cooling load would be 254, which, with the wall leakage (5,914), would total about 6,349 B.t.u. per 24 hours.

The ice melting effect or ice equivalent can be found by simply dividing the B.t.u. total by 144, which represents the number of B.t.u. required to convert one pound of ice at 32° F. to water at 32° F. and is known as the latent heat value of ice.

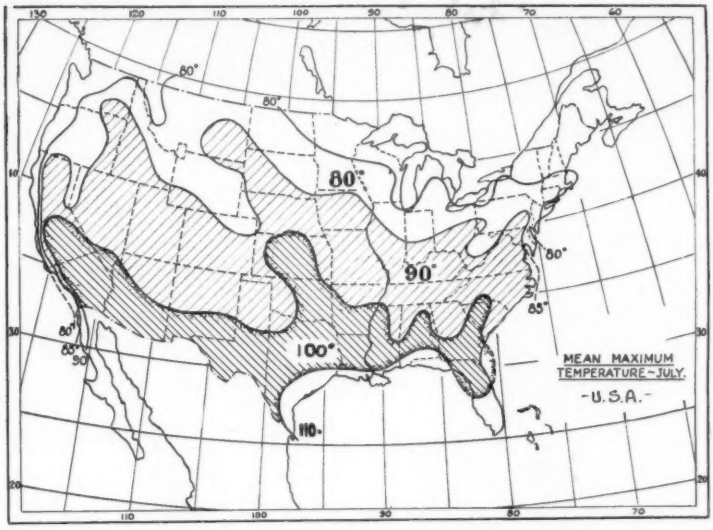


FIG. 5. AVERAGE TEMPERATURE BELTS.

Thus: 6,349 ÷ 144 = approximately 44 1/12 pounds of ice per 24 hours, required to keep the refrigerator and its contents at 50° F. under the conditions mentioned previously.

Problem—Household Installation

An apartment hotel contemplates converting refrigerators to the mechanically cooled type. The ice boxes are of excellent construction, porcelain lined and having a sheet cork insulation of 1½ inches. A study of the apartment hotel reveals the fact that there are 15 four cubic feet boxes and 10 seven cubic feet boxes, the smaller boxes being in one line and the larger boxes in another. The building is five stories in height and has two large and three small apartments on each floor. The layout of the kitchens reveal that all the smaller apartments can be supplied from a common riser pocket in the walls and the larger apartments supplied by an individual riser pocket devoted to supplying the larger apartments.

Therefore, in running the lines all of the small refrigerators would have to be grouped on one line and the larger ones on another separate line. Since the owner does not want individual units the problem is to work out the size of the apparatus required.

The apartment hotel will be assumed to be located in the north.

Since it is at once apparent that the small household machine cannot be adopted to this job, the problem would resolve itself into one of two solutions. Either one large unit could be used, or since there are two lines, two units could be installed, one to take care of the load imposed upon each line.

Computing Load

Going back to some of our previous work, we would find a four cubic feet box, exposed to northern conditions and having an insulation rated as "excellent," listed at 4,100 B.t.u. load per 24 hours. Boxes of seven cubic feet, of "excellent" construction, under the same conditions have a heat load of 5,500 B.t.u. per 24 hours.

Therefore, if the 15 four cubic feet boxes are connected on one line, the load would be:

$$4{,}100 \times 15 = 61{,}500 \text{ B.t.u.}$$

The 10 seven cubic feet boxes would have a total load of:

$$5{,}500 \times 10 = 55{,}000 \text{ B.t.u.}$$

If one large unit is used its capacity would have to be:

$$61{,}500 + 55{,}000 \text{ or } 116{,}500 \text{ B.t.u.}$$

Assuming a 16-hour running period per 24 hours, a machine capacity of:

$$\frac{24}{16} \times 116{,}500 = 174{,}750 \text{ B.t.u.}$$

would have to be selected. Or, if two smaller units are used, based on the same running time, the capacities would have to be:

$$\frac{24}{16} \times 61{,}500 = 92{,}250 \text{ B.t.u., and}$$

$$\frac{24}{16} \times 55{,}000 = 82{,}500 \text{ B.t.u.}$$

By adding the capacities of the two smaller units together the capacity of the larger and correctness may be checked. Thus,

92,250 + 82,500 equals 174,750 B.t.u.,

which checks with the large capacity machine rating, indicating that all our computations are correct:

$$\frac{24}{16} \times 116{,}500 = 174{,}750 \text{ B.t.u.}$$

Insulation as we all realize is an important factor on any refrigeration job, so the service man should secure all the information possible.

The Question Box

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box." The following questions are answered by Mr. George H. Clark.

DRILLING HOLE IN GLASS

QUESTION 190. *Will you please tell me how I can drill a quarter-inch hole in an opalite glass counter top?*

ANSWER: I have been informed that one of the best methods of drilling a hole through a glass counter top consists in starting with a very small three-cornered file with sharpened corners and using this in connection with a breast drill, keeping the surface of the glass well covered with some suitable fluid, such as glycerine. It is important to not force the file as the glass is very likely to crack. The size of file used can be increased until the hole of the desired size is obtained.

PROPER REFRIGERANT CHARGE

QUESTION 191. *(1) Determining the proper charge of a small domestic unit; an article in one of last year's issues stated that one-half pound of gas is sufficient for most of these units of the dry expansion type, or enough liquid in the receiver tank to keep the (L.R.V.) stem submerged. If this statement is true, which I think it is, why should there be so much dispute on the amount of liquid a machine requires? In a flooded domestic refrigerator, say any Frigidaire; if there is just enough liquid to cover the (L.R.V.) stem, would an added 2 or 3 lbs. of SO_2 increase the efficiency if there were ample room for the extra 2 or 3 lbs. of SO_2?*

(2) Please explain how a temperature as low as 30° can be maintained with a forcedraft unit and still keep the forcedraft unit working free of frost? In the December issue, one of the don'ts of the unit cooler is—don't try to obtain a temperature much below 30° in the refrigerator.

ANSWER: There is no advantage in having more refrigerant in the system than just enough to amply cover the opening into the liquid line. Additional refrigerant in the receiver may simply mean that a small leak in the system may occur and may not be noticed as quickly as when there is only a small amount of liquid. In other words, you might lose two or three pounds of refrigerant before the system stopped refrigerating properly, while with the smaller quantity of refrigerant, as soon as a small amount leaked out, the refrigeration would be affected.

An additional amount of liquid in the receiver to some extent decreases the efficiency of the system in that it will fill up part of the receiver which normally adds to the condensing surface in the system. If the receiver is quite large, it may be possible that slightly more refrigerant may be required

for summer operation than for winter operation. This would be due to the fact that with increased condensing pressures, the receiver may hold a greater weight of refrigerant in the vapor form than during the cooler months when a lower condensing temperature obtains. This difference in refrigerant quantity for summer and winter conditions would hardly be more than one-quarter pound of refrigerant for any household machine.

I do not believe it is practicable to try to maintain temperatures as low as 30° on a forced draft cooler. In my experience 34° to 36° is as low a temperature as can reasonably be obtained with this type of coil. Lower temperatures might be obtained if some sort of quick defrosting arrangement were employed frequently in the use of this type of coil.

FLOAT LIFTER FOR G.E.

QUESTION 192. *I have tried to make a float lifter for a G.E. machine and have wound two lbs. of number 15 wire on a one inch round iron core with an additional horse shoe magnet arrangement fastened around the top as an additional core, but find the float does not even begin to move. Even using direct current in this magnet it seems to have absolutely no effect on the float, although same is very free.*

I would appreciate any information you may be able to give in regard to making a float lifter.

Also, there are a series of resistances in connection with these sealed units such as Westinghouse and General Electric, and if it is at all possible for me to obtain the Ohm's resistance and capacity of these various coils, this information would be of great help in many instances.

ANSWER: I have tried to get some information with respect to the particular problems which you have. Here is the opinion of an experienced General Electric engineer:

"The General Electric Refrigerators are equipped with a float valve of such construction that a magnetic float valve lifter can be used successfully. As a matter of fact, the General Electric Company has available under definite catalogue numbers several different types of float valve lifters designed for use on their various refrigerating machines. The location of the float valve on the various units necessitates several different types of float valve lifters. A magnetic float valve lifter of one of these types can be used on all of the General Electric household refrigerating machines utilizing the high side float.

"One of these float valve lifters incorporates a copper oxide rectifier in conjunction with a magnetic coil and core. It is fairly effective provided it is used intermittently to avoid burning out the rectifier. Other types consist of merely a hollow magnetic coil for use on those machines where the float is so located that a core type lifter cannot be used.

"I am at a loss to answer your question concerning the resistance of the various units. I fail to see why the motor winding resistance would be of any particular value to the service engineer. In some of our older machines there is a resistance element incorporated in the control device. This resistance is used entirely on starting. Later types and all of the so-called conventional types in alternating current use a capacitor type motor. It is true of course, that all General Electric refrigerating machine controls incorporate a heater element for overload protection. Technically, this element, of course, is a resistance unit but of such resistance that the normal full load motor current will not heat it beyond the trip out temperature."

Also a Westinghouse engineer furnishes the following information:

"In your letter of December 10 you asked the question as to how much resistance we use in connection with the sealed refrigerators put out by the Westinghouse Company. In reply to this question, I would advise you that we do not use any resistors in series with our refrigerator motors either in the starting or running winding. The motors are designed for single phase operation, and the starting winding as well as the running winding is connected when the contacts of the control close. When the speed of the motor has come up to normal, the starting contacts open thus switching out the starting winding and leaving the running winding so that the motor operates as a single phase induction motor. We do not use any heater coils of any kind in the machine nor any other type of resistors."

ALCOHOL ODOR IN ICE CREAM CABINET

QUESTION 193. *I am seeking information regarding a Kelvinator ice cream cabinet. This is a 12-hole cabinet, using SO_2 refrigerant, alcohol and water for a hold-over solution. The odor from the alcohol is seep-*

ing into the sleeves, causing the ice cream to taste of it.

I have tried changing to calcium chloride on one unit, but had the same odor, which I could not get rid of. Is there any solution you could advise?

ANSWER: The calcium chloride solution should not cause any odor in the ice cream cabinet provided the alcohol has been thoroughly cleaned out before the new solution was added. I would suggest that the cabinet be cleaned out thoroughly so as to absolutely eliminate all alcohol from the cabinet and then a brine solution of glycerine and water or ethylene glycol and water may be used. Either of these solutions will give you a brine free from odor and at the same time will not give you the corrosive effect which we get when using a calcium chloride brine.

EUTECTIC SOLUTIONS

QUESTION 194. *I would like to get some more information on eutectic freezing solutions, such as described in your October 1936 article.*

My main interest is the names of other solutions besides barium chloride, their specific heats, etc.

If you can let me have this information or give me the manufacturer's name, it will be greatly appreciated.

ANSWER: With respect to the various solutions besides barium chloride which may be used as eutectic freezing solutions, I include a table from the lesson material as used by the Detroit School of Refrigeration and Air Conditioning:

EUTECTIC FREEZING POINTS OF SOLUTIONS

NAME OF SOLUTION:	CHEMICAL FORMULA	PER CENT BY WEIGHT	TEMPERATURE FAHRENHEIT
Sodium Sulphate	$NaSO_4$	4.9	plus 30.0
Potassium Sulphate	K_2SO_4	6.5	plus 28.3
Sodium Carbonate	$NaCO_3$	8.0	plus 28.2
Potassium Nitrate	KNO_3	11.5	plus 26.6
Barium Chloride	BaCl	23.0	plus 17.0
Potassium Chloride	KCl	19.7	plus 12.8
Ammonium Chloride	NH_4Cl	19.1	plus 4.3
Ammonium Nitrate	NH_4NO_3	42.8	plus 2.0
Sodium Nitrate	$NaNO_3$	39.7	plus 0.6
Sodium Chloride	NaCl	23.3	— 6.0
Potassium Carbonate	KCO_3	35.5	— 34.7
Calcium Chloride	CaCl	32.4	— 59.8

HIGH SIDE FLOAT ON DRY EXPANSION SYSTEM

QUESTION 195. *We have an inquiry from a refrigeration dealer regarding high side floats. They propose putting a high side float on a dry expansion milk cooling job, the specifications of which are as follows:*

The load is 2400 gallons of milk per hour, which is approximately a 5 ton load, using methyl chloride. The machine has a 1½ inch hard drawn copper pipe suction line.

We should very much appreciate any information on high side floats regarding capacities, liquid line sizing for above job.

ANSWER: I have checked into the matter of high side floats and as near as I can determine there are none made which have sufficient capacity for the job in mind. If it is necessary to use high side floats, this could be done by making a parallel bank of three of the high side floats which may be obtained from the market. It would be possible, of course, to enlarge the orifice so as to pass enough refrigerant for the load in mind but this would involve difficulties in making the float valve open with high pressures in the float chamber and a low pressure in the evaporator coil.

I would suggest that it would be much more advisable to use a thermostatic expansion valve possibly with a vapor charge to insure that no trouble develops due to flooding through refrigerant during an off period and to limit the load on the refrigerating machine with the evaporator operating at high temperatures.

A suction line between 1½ inch and 1¾ inch should be suitable if the evaporation temperature is to be 0 degree. With a 20 degree evaporation temperature the 1½ inch suction line would be just right, while if the evaporating temperature was to be 30 degrees, the 1½ inch line would be slightly larger than might be required. The liquid line should be approximately ⅜ of an inch inside diameter for short runs and a one-half inch tube size will be suitable for any normal length of refrigerant line.

Sixth Article — *Capacitor and R. I. Motors*

Electronics for Servicemen

By WALTER G. CHRISTIE, B.S.E.E.

IN the April article, we studied how polyphase motors operate. We learned that when power is supplied to the field windings of a polyphase motor, a revolving field is set up between the motor frame and the motor armature. This revolving field drags the iron armature around much like a horseshoe magnet will drag an iron nail along the top of a table even though the magnet is not in actual contact with the nail.

We also learned that if power is supplied to only one phase of a two-phase motor, the magnetic field will *not revolve;* it will merely oscillate back and forth and the armature will not revolve; it will merely vibrate and hum.

Now if single-phase power will not set up a revolving field inside the motor, how can a single-phase motor start?

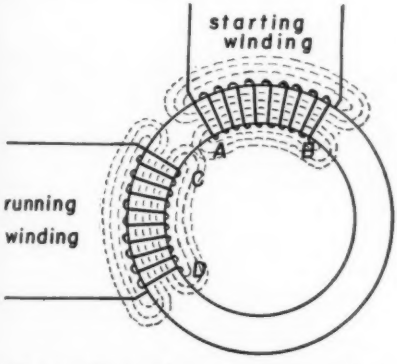


Fig. 1. The capacitor motor has two separate windings set at 90° to each other like the windings in the two-phase motor.

To find the answer, let's first consider the capacitor motor. The field winding of this type motor is similar to that of the polyphase motor. There are two separate windings located 90 degrees apart as shown in Fig. 1. However, the two windings on a capacitor motor are not made with the same size wire. One winding is called the starting or phase winding; the other is called the running or main winding. The starting winding is wound with smaller wire than is the running winding; hence it has *more resistance* than the running winding.

The starting winding is connected in series with the centrifugal switch and with a starting capacitor, as shown in Fig. 2.

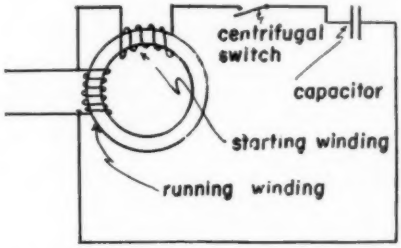


Fig. 2. The starting winding is connected in series with the centrifugal switch with the starting capacitor.

Hence, any current which flows into the starting winding must pass through the switch and the capacitor.

The capacitor is called a *condenser* by electrical engineers and radio men. In its simplest form it consists of two long strips of tinfoil separated by a piece of paper. Then the two strips of tinfoil are covered with paper and the assembly is wound into a flat coil. A wire is soldered to each strip of tinfoil. These wires provide a means of

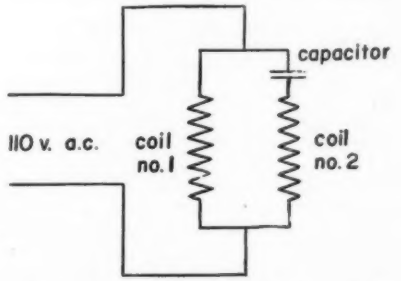


Fig. 3. If two coils are connected in parallel to a source of a.-c. voltage, and one coil has a capacitor in series with it, the current in coil No. 1 wi'l be 90° out of phase with that in coil No. 2, as shown in Fig. 3-a.

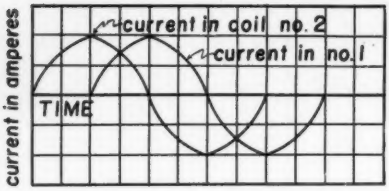


Fig. 3a

connecting the capacitor to the electrical circuit.

Now this simple device has several noteworthy characteristics, among which are:

1. It won't pass direct current.
2. It will pass alternating current, but when a.-c. is passed through a capacitor, its phase is changed.

That is, if two circuits are connected in parallel to the a.-c. supply source as shown in Fig. 3, the current flowing through coil number 1 will be out of phase with that flowing through coil number 2. If the condenser has a large enough *capacity*, the current flowing through coil 2 will be 90° out of phase with that of coil 1.

From this description, we should now know the secret of how a capacitor motor works. The schematic diagram of a capacitor motor is shown in Fig. 4. The current

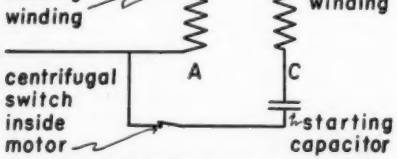


Fig. 4. Schematic diagram of a capacitor motor. Current passing through the starting winding is 90° out of phase with that in the running winding because of the capacitor. As a result, the revolving field is set up inside the motor, and the motor starts. When the motor is up to speed, the centrifugal switch opens and stops the flow of current to the starting winding. The motor then runs as an induction motor on the running winding alone.

flowing through the winding AB will be 90° out of phase with that in winding BC. Hence, we have the same conditions inside the capacitor motor field that we had in the polyphase motor field and we will have a revolving field produced inside the motor frame in the same way as in the polyphase motor.

The armature of the capacitor motor is made the same way as that of the polyphase motor; that is, it is made up of circular steel plates or laminations pressed onto the motor shaft and held tightly at the outer edges by copper bars which pass through the laminations and which are soldered at either end of the armature to a brass plate.

However, the armature of the capacitor motor has attached to it a pair of weights and a centrifugal switch operating mechan-

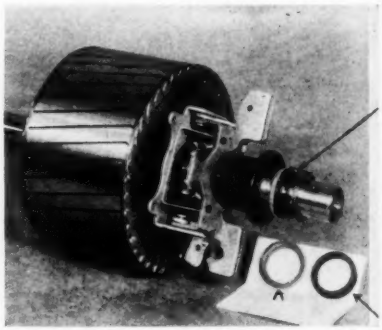


Fig. 5. Armature of a capacitor motor, showing ends of copper bars, centrifugal weights and switch collar.

ism as shown in Fig. 5. The centrifugal switch is fastened to the motor end bell. When the motor is stopped, springs pull the centrifugal weights together and they pull the switch operating mechanism away from the centrifugal switch so that the *switch contacts close*. Now when the motor starts and the armature gets up to speed, the centrifugal weights overcome the retaining action of their springs and fly outward. This forces the switch operating mechanism against the centrifugal switch *thus opening the switch contacts and disconnecting the starting winding from the current supply.*

Now when this happens, *we know that the magnetic field inside the motor stops revolving.* Then what makes the motor keep operating after the starting winding has been disconnected?

Up to this time, we have explained that the revolving field dragged the iron armature around because of magnetic attraction. This was done for simplicity's sake so that the reader might better absorb what we wanted to bring out about the action of the revolving field. Now in order to describe how the capacitor motor runs on one winding after it is up to speed, it is necessary to

describe the exact mechanism of the induction type armature used on both capacitor and polyphase motors.

As explained before, *copper bars extend through the armature and are soldered to a brass plate at either end of the armature. These are the important parts of the mechanism of a polyphase armature.*

From our previous study in this series (article four in particular), we learned that any time a conductor is cut by a magnetic field, a voltage is set up in that conductor. Now we also learned that if the ends of this conductor are joined together, a current will flow in this conductor and we know that every conductor which is carrying current has a magnetic field surrounding it.

From the facts in the foregoing paragraph, we can find out how the revolving field causes the motor to start. To begin with, the revolving magnetic field cuts across the copper armature bars, and thus sets up a voltage between the ends of each bar. Since the ends of all bars are short-circuited by the brass plate, a heavy current flows through the bars. Because of this heavy current, a strong magnetic field is set up around each bar. Because of a natural law of physics, *this magnetic field at all times opposes the magnetic field which creates it.* Hence, as the magnetic field revolves, an opposing magnetic field is set up around the armature. The opposition of these two magnetic fields causes the armature to start to revolve.

Now when the armature is up to speed, *the revolving field is no longer required, provided the main field is properly located around the motor frame as it is in the capacitor motor.* Let's see why this is so.

When the capacitor motor is up to speed, the centrifugal switch disconnects the starting winding from the circuit and hence the revolving field between the starter and the armature is replaced by an oscillating field from the running winding alone. *Now remember that the armature is revolving. This means that the copper bars of the armature are cutting the oscillating field from the running winding. As a result, current continues to flow in the copper bars of the armature, and a magnetic field is set up around the armature which at all times opposes the magnetic field from the starter.* This means that as the field from the running winding changes its direction, the field around each bar also changes its direction so that the magnetic force from running winding at all times opposes the magnetic field around each armature bar. Hence, the motor continues to run with only one field connected to the supply circuit.

The Repulsion-Induction Motor

The repulsion-induction (hereafter referred to as the r.i. motor) is widely used on refrigerators. It uses a different method of getting started from that used on polyphase and capacitor motors in that it works something like the direct-current motor.

Like the d.-c. motor, the armature of the r.i. motor is wound with wire, and taps are taken off this winding at regular intervals around the periphery of the armature and are soldered to a copper commutator. However, unlike the d.-c. motor, *there is no electrical connection between the armature and current supply.* You can touch the brushes

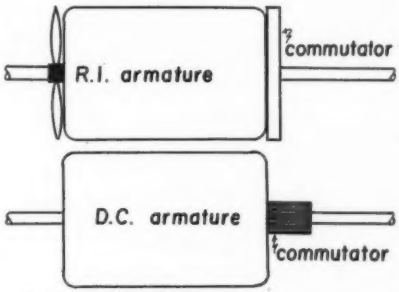


Fig. 6. Commutators on most r.i. motors up to ½-hp. are vertical, whereas commutators on d.-c. motors are horizontal.

on a r.i. motor at all times without danger of getting a shock. You'll remember from article three, that the brushes on a d.-c. motor are connected to the supply line directly and therefore they are always "hot."

On most r.i. motors up to ½ h.p., the commutator is vertical (see Fig. 6), whereas the commutator on a d.-c. motor is horizontal. On most r.i. motors over ½ h.p., the commutator is horizontal like that on d.-c. motors. However, some manufacturers (Century and Wagner) use the vertical commutator on the larger size motors.

Before trying to understand how r.i. motors work, let's find out how the r.i. motor is built.

The field of a r.i. motor is generally made up of two separate windings. These windings may be connected in parallel or series depending on whether the motor is to be used on a 110 volt circuit or a 220 volt cir-

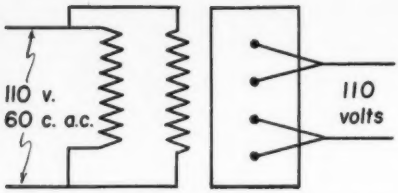


Fig. 7. (Left) Internal connections of a r.i. motor connected for 110-volt operation. (Right) External connections on r.i. motor connected for 110-volt operation.

cuit. Figures 7 and 8 show the internal and external connections of an r.i. motor.

The armature of an r.i. motor has number of parts as shown in Fig. 9. The centrifugal weights in Fig. 9 are closed when the motor is at rest. As the motor starts, the weights fly outward and force the pins or rods toward the commutator. The pins push the necklace collar toward the commutator.

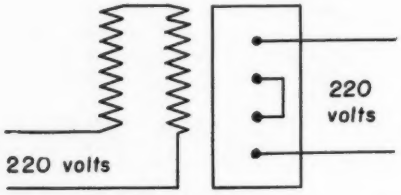


Fig. 8. Internal and external connections of a r.i. motor connected for 220-volt operation.

When the motor is up to speed, the necklace collar is flush with the commutator and the necklace (which is wrapped around the necklace collar) strikes the inside edge of the commutator and short-circuits the commutator. The brush holder rests against the necklace collar at all times. When the motor is at rest, the necklace collar is inside the motor and the brushes are pressed against the commutator. As the motor starts, the weights start to move outward and thus carry the necklace collar toward the commutator and carry the brush holder away from the commutator. When the motor is up to speed, the brushes leave the commutator.

When current is cut off from the fields, the brush holder spring forces the brush holder towards the commutator. This forces the necklace collar into the armature which in turn pushes the motor pins against the centrifugal weights and pulls the weights closed. When the motor is at rest, the brushes are against the commutator and the motor is ready to start.

How the Repulsion-Induction Motor Works

When the motor is stopped, the brushes short circuit parts of the armature winding. For simplicity's sake, let's consider the schematic diagram of a two-pole r.i. motor in Fig. 10. Here the actual armature winding is replaced by the equivalent short-circuit armature winding. Notice that the position of the equivalent armature winding can be

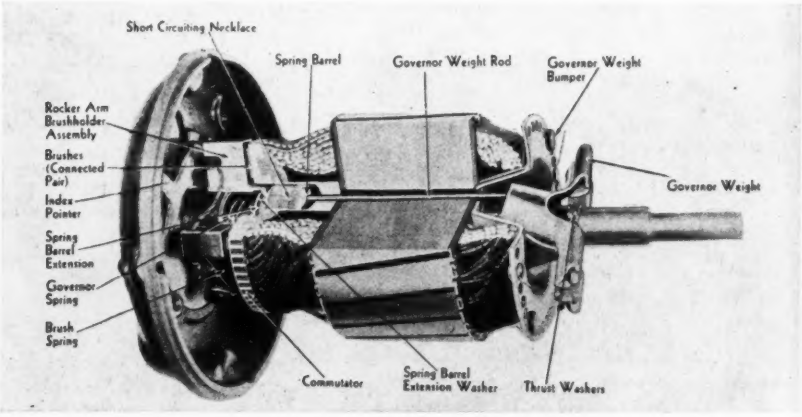


Fig. 9. Typical repulsion start induction running rotor, showing short-circuiting and brush-lifting mechanism.

Fig. 10

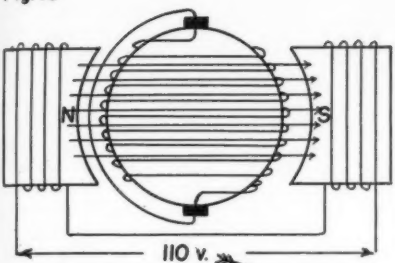


Fig. 10 a

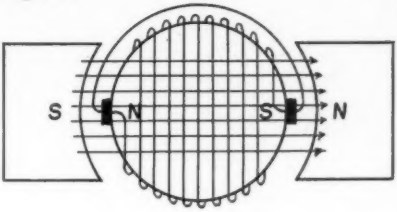


Fig. 10 b

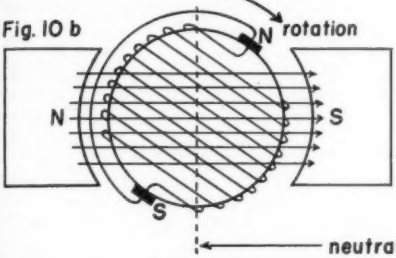
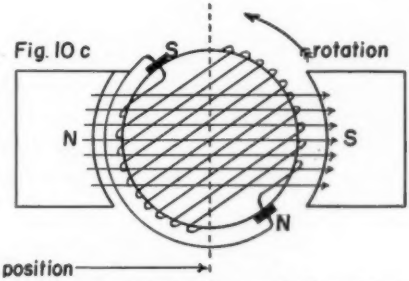


Fig. 10 c



neutral position

Fig. 10. Lines of flux are parallel with windings. Hence, windings do not cut lines of force and armature does not become magnetized. In Fig. 10-a, all windings cut lines of force, but magnetic field of armature is adjacent to that of field and motor can't start. In Fig. 10-b, winding is cut by lines of force and armature becomes magnetized as shown. As a result, armature revolves clockwise. In Fig. 10-c, armature revolves counter-clockwise.

Fig. 13. Same as Fig. 10-b. When the brushes are shifted to the right of neutral, the armature is cut by the field flux so that the top of the armature is a north pole. Armature revolves as shown.

Fig. 13-a. Same as Fig. 10-c. When brushes are shifted to left of neutral, top of armature is made a south pole, and motor revolves as shown.

changed by shifting the brushes as shown in Fig. 10A, 10B, and 10C.

When current flows through the field winding, magnetic flux oscillates back and forth between the poles of the motor. This flux will start at zero, build up to a maximum value, decrease to zero, build up to maximum value in the opposite direction and then decrease to zero again as shown in Fig. 11.

Now if the brushes are in position as shown in Fig. 10B, the flux will cut many of the windings on the equivalent armature (Fig. 10B) and cause a current to flow in the armature.

Now on one-half of the cycle, the current in the field winding will flow in the direction shown in Fig. 12. If the left pole is made a north pole and the right a south pole, as in Fig. 12, the armature will become magnetized. Then the north pole of the armature will be attracted to the south pole of the field and the armature will revolve clockwise as indicated in Fig. 12. Since the brushes are stationary, the armature will turn but the position of the armature magnetism will remain the same so that the force of attraction between the armature and the field is maintained as long as the current is on the positive half of the cycle.

Now what happens when the current reverses its direction?

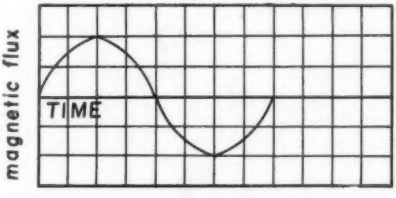


Fig. 11.

The former north pole of the field now becomes a south pole and the south pole becomes a north pole. *As a result, the direction of the field cutting the armature is reversed and so the current flowing in the armature is reversed.* This makes the magnetism of the armature reverse and what was formerly the north pole of the armature now becomes the south pole.

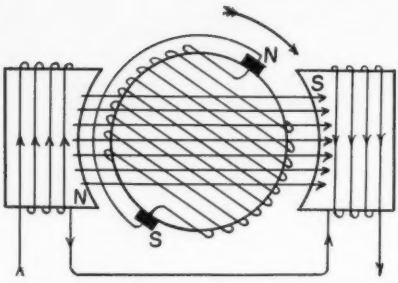


Fig. 12. When current flowing through the field circuit is on the positive cycle, the left pole becomes the north pole, and the right pole the south pole. Because of the angle of the brushes, the armature becomes magnetized as shown. There is a force of attraction between the north of the armature and the south of the field, and the armature revolves clockwise.

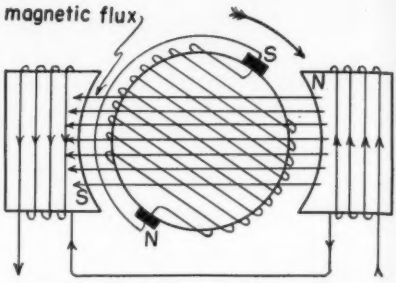


Fig. 12-a. When current flowing through the field is on a negative cycle, the field magnetism reverses from that shown in Fig. 12. As a result, the flux cuts the armature winding in the opposite direction, and the armature magnetism reverses its direction. Hence, the force of attraction between armature and field is the same as in Fig. 12, and the armature continues to revolve in a clockwise direction.

Continued on Page 38

Determining Volumetric Efficiency of Compressors

Several important factors enter into problem of ascertaining compressor efficiency. Here are some practical suggestions and comparisons.

GEO. H. CLARK, *B.S., M.E.

IN considering the use of compressors in refrigeration work we are concerned with two types of compressor efficiency. One of these is volumetric efficiency which has to do with the result of the volume of gas moved by the compressor in a given length of time compared to the displacement of the compressor for the same period of time. There are a number of design features which affect volumetric efficiency.

We are also interested in the mechanical efficiency of a compressor. By mechanical efficiency we mean the result of the work done by the compressor to the work done on the compressor. It does not follow that a compressor having highest volumetric efficiency is necessarily one having the highest mechanical efficiency, as these are entirely separate terms and have entirely different meanings.

The factors which affect volumetric efficiency to a great extent consist in the ratio of clearance volume to displacement and is concerned also with the difference that results between the inlet and outlet pressures and further with the throttling or wire-drawing action through the valves, both suction and discharge, and with the fit of the compressor piston in its cylinder. In order to have a compressor then, having highest volumetric efficiency we want to be sure that all these features are considered.

Let us consider first the effect of clearance volume. Suppose we were to have a compressor, to show an exaggerated case, having a nine inch stroke and a clearance volume in the cylinder equivalent to one inch of stroke and suppose that the suction pressure was 20 lbs. per square inch absolute pressure and that the discharge pressure is 100 lbs. per square inch absolute pressure. If the piston were at the bottom of its stroke and the cylinder was filled with a charge of gas at 20 lbs. absolute pressure and the piston started moving up the cylinder the pressure above the piston would increase until the pressure above the piston was slightly higher

*President, Detroit School of Refrigeration. Chairman, Educational and Examining Board, R.S.E.S.

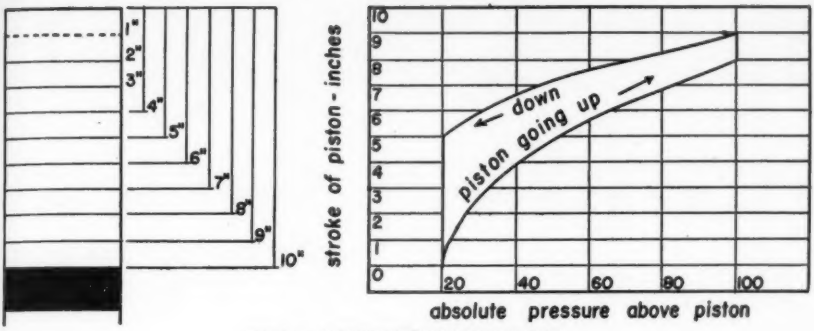


FIG. 1. PRESSURE VOLUME STUDY

than 100 lbs. per square inch absolute and then gas would be pushed through the discharge valve for the remaining length of stroke and when the piston was up to the top of the cylinder we would have gas in the cylinder at 100 lbs. absolute pressure and a volume equivalent to one inch of stroke. As the piston moves down the cylinder the gas at high pressure will expand until the 20 lbs. per square inch pressure is reached when a fresh charge of gas would be drawn into the cylinder.

Pressure Volume Study

Fig. 1 shows a pressure volume study of what goes on in the compressor cylinder with the piston 10 inches from the end of the cylinder and the cylinder filled with gas at 20 lbs. per square inch absolute. The pressure goes up as the piston moves up in the cylinder.

Assuming no change in temperature, if the volume of the gas was decreased to one-fifth of the original volume the pressure would be increased to five times the original absolute pressure. In order to raise the pressure then up to 100 lbs. absolute the piston would have to move eight inches or four-fifths of the way from the extreme down position to the top of the compressor cylinder. This would in eight inches of stroke raise the pressure to 100 lbs. per square inch and then would discharge gas for one inch of stroke to make up the total of 9 inches. The gas would be moved out of the cylinder at 100 lbs. per square inch.

If the piston moved another inch until the displacement volume was zero then all the gas would be moved out of the compressor. As it is, it only moves out one-half of the volume, then if the piston moved down the stroke the volume increases until the piston is five inches from the top of the cylinder or four inches down its stroke when the volume will be five times the volume above the piston at the top of its stroke. By this time the pressure above the piston will be down to 20 lbs. per square inch absolute and for the next five inches of stroke the compressor will be drawing in a fresh charge of gas. In a case of this kind the actual gas drawn into the compressor cylinder is the area of the piston times the five inches of stroke during which period gas was drawn in, while the displacement of the piston is equal to the area of the piston times the length of the stroke which was nine inches so that the volumetric efficiency provided that everything else was absolutely perfect would only be five-ninths or 55.6%.

Effect of Increased Stroke

We can show the effect of increasing the stroke on volumetric efficiency by assuming that we have a compressor working under the same conditions and in an exaggerated case we assume that we have 19 inches stroke with one inch clearance volume and we are drawing gas at 20 lbs. absolute and discharging at 100 lbs.

Fig. 2 shows the pressure volume study under this condition. If the piston moves from a distance 20 inches below the compressor head to a distance four inches below the compressor head the pressure has changed from 20 lbs. absolute to 100 lbs. absolute and the piston has covered 16 inches of its total stroke. During the last three inches gas is pushed out at an absolute pressure of 100 lbs. per square inch. As the piston moves down the cylinder the gas in the one inch clearance volume and 100 lbs. per square inch expands until the piston is five inches from the top of the cylinder or four inches down its stroke at which time the pressure above the piston will be down

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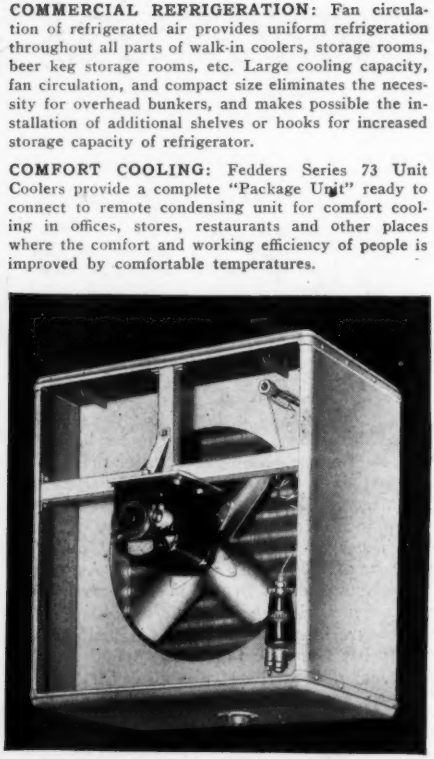

Rear view showing rubber mounted motor and fan assembly, Fedders Thermostatic Expansion Valve, hanger and drain connection on new series 73 Unit Cooler.

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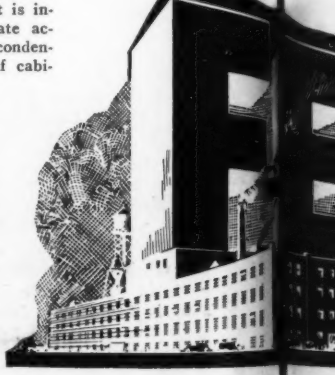

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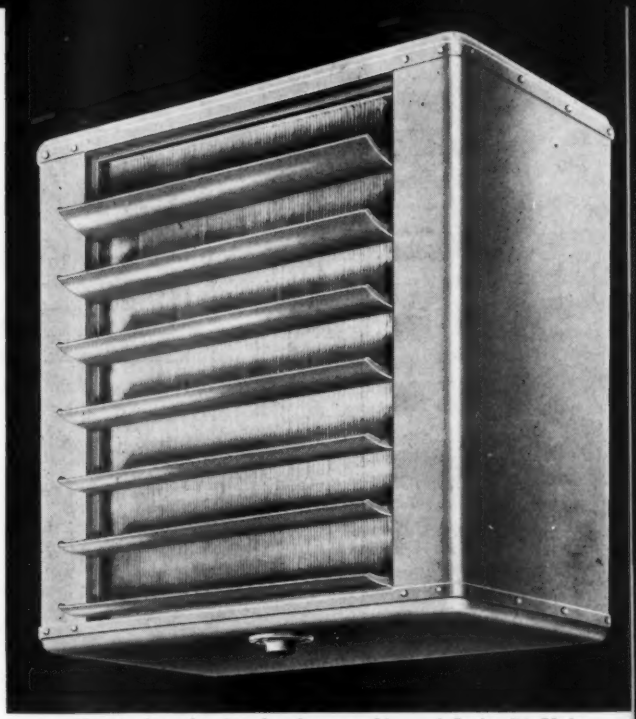

Front view showing handsome cabinet of Series 73 Unit Cooler. Louvers not furnished as standard equipment but available when specified.

RMOSTATIC EXPANSION VES: Fedders Thermostatic Expan- Valves are standard equipment, pro- accurate refrigerant control, and ting the unit cooler to be connected ltiple with other lowside equipment ing from a single condensing unit.

TORS: Fully enclosed moisture- motor of standard make is mounted rear. Constant and three speed 110 60 cycle, A. C. motors are standard ment. Motors for all other current cteristics are available.

IN CONNECTION: Bottom of t is equipped with ½" pipe tap connection for carrying off con- te.

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RIGERANTS: Fedders Series 73 draft Unit Coolers are built for use with all standard refrigerants except ammonia.

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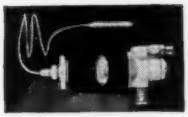
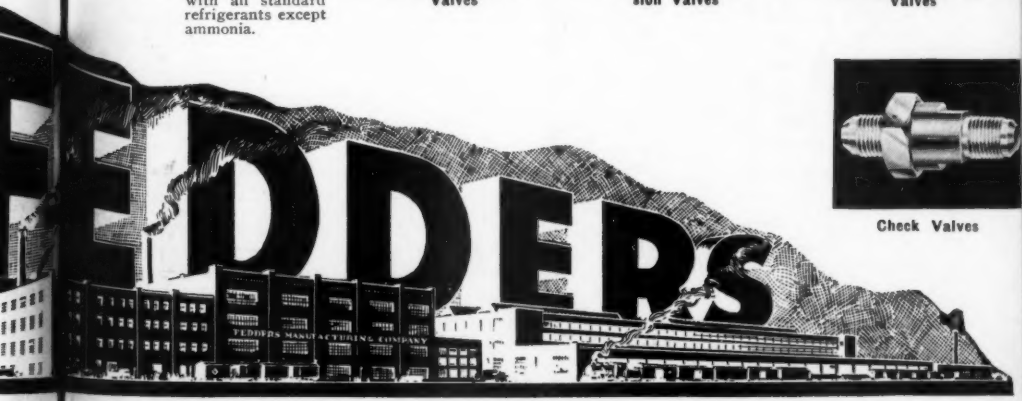


Thermostatic Expansion Valves

Automatic Expansion Valves

Check Valves



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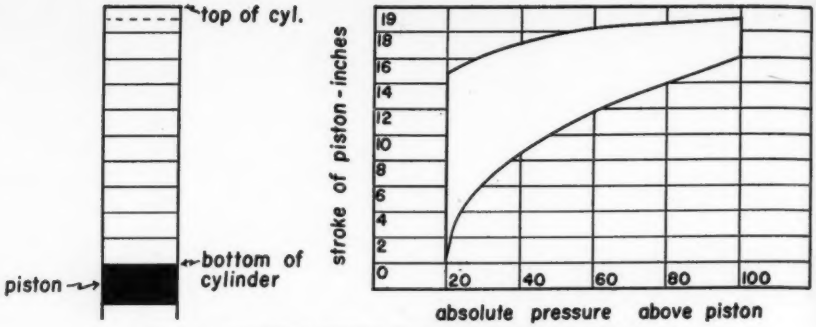

FIG. 2. SHOWING EFFECT OF COMPRESSION IN CYLINDER

to 20 lbs. absolute pressure. In this case a fresh charge is drawn into the cylinder through the remaining stroke which is 15 inches and the volumetric efficiency in this case with everything else perfect would be $15 \div 19$ or approximately 78%, which illustrates that in general the volumetric efficiency will be higher when the stroke is long in comparison to the displacement volume in the cylinder.

We can also show that the volumetric efficiency varies according to an increase in discharge pressure.

Returning to the original example where we have a nine inch stroke with one inch clearance, let us say that we still draw in gas at 20 lbs. absolute pressure and discharge at 200 lbs. absolute pressure. In this case, if the piston moves up the cylinder until the volume in the cylinder is one-tenth of the original volume the piston will be one inch from the top of the cylinder and will then have reached 200 lbs. per square inch absolute pressure. But the piston being at the top of its stroke will not discharge any gas, with the result that as the piston moves down the cylinder again the gas above the piston simply expands to fill the full cylinder volume with the result that no gas will be drawn in at 20 lbs. absolute pressure.

Consequently, the volumetric efficiency in this case would be zero so that the highest possible pressure that a compressor of this kind could give us with a 20 lbs. suction pressure would be 200 lbs. per square inch absolute. At any pressure lower than 200 lbs. absolute pressure we would move some gas through our compressor. This demonstrates that an increase in head pressure will decrease our volumetric efficiency.

We can also demonstrate that a decrease in suction pressure affects our volumetric efficiency. We will consider the same compressor drawing gas in now at 10 lbs. absolute pressure and discharging at 100 lbs. absolute pressure.

Fig. 3 shows the pressure volume study of what happens in this case in which the piston has a charge of gas in the cylinder at 10 lbs. per square inch absolute. This volume

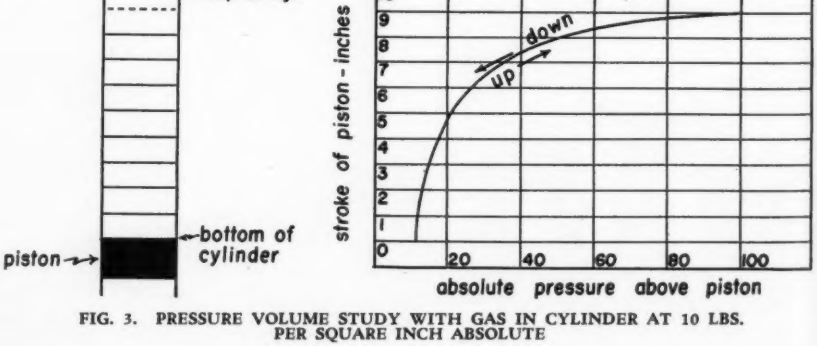

FIG. 3. PRESSURE VOLUME STUDY WITH GAS IN CYLINDER AT 10 LBS. PER SQUARE INCH ABSOLUTE

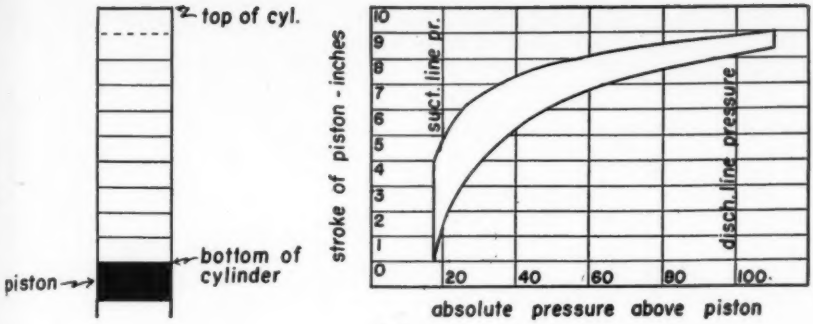

FIG. 4

of gas is compressed, raising its pressure up to 100 lbs. per square inch absolute when the volume is one-tenth of the original volume. This means that the piston will have to move nine inches up the cylinder and since this is the total length of stroke, no gas will be pushed out through the discharge valve with the result that the displacement volume gas will expand and fill the whole cylinder as the piston moves down to the bottom of its stroke so that in this case also no fresh gas is drawn into the cylinder and consequently the volumetric efficiency would be zero.

The lowest suction pressure that could be produced then with a discharge pressure of 100 lbs. absolute would be 10 lbs. absolute pressure. This demonstrates that as the suction pressure is decreased the volumetric efficiency is decreased. In addition to these elements which affect volumetric efficiency we are also concerned with the design of the valves in the compressor.

Fig. 4 shows a pressure volume study of a compressor which has discharge valves so designed that the pressure above the piston has to be 10 lbs. above the pressure of 100 lbs. absolute in order to push the gas through the valves. It also shows that the piston valve or suction valve is so designed that the suction pressure has to be two lbs. per square inch below the line suction pressure of 20 lbs. absolute.

In this case, as our cylinder fills with gas due to the two lbs. drop in pressure through the suction valves, the cylinder is actually filled with gas at a pressure of only 18 lbs. per square inch absolute. In order to discharge this gas with this compressor we have to raise the pressure from 18 lbs. absolute to 110 lbs. absolute which we do by decreasing our volume to 18/110 times the original volume so that the piston will then be 1.64 inches, approximately, from the top of the cylinder before a sufficient pressure is reached to discharge gas, and the piston moves an additional 1.64 of an inch in pushing out its charge at 110 lbs. absolute pressure.

Then we have our one inch displacement volume which expands down our stroke until the volume is 110/18 of the clearance volume or until the piston is 6.1 inches from the top of the cylinder or has moved 5.1 inches from its top position. This means that gas will actually be drawn into the compressor for a distance of 3.9 inches which indicates that the maximum volumetric efficiency with all other factors being perfect would be $3.9 + 9 = 43.3$ per cent. This demonstrates that due to the throttling action of our valves alone, we have decreased our volumetric efficiency from 55.6 to 43.3 per cent.

In all of these cases (highly exaggerated to illustrate the point) we have considered all conditions perfect except the one we were demonstrating in connection with these features which affect volumetric efficiency.

We must also consider the leakage by the piston and no piston is free from leakage entirely. We must also consider the leakage through piston or suction valves which will mean that gas leaks back by the piston and suction valves as the piston is moving upward in its stroke which means that the full volume of gas is not being compressed to be discharged through the discharge valve but that some of it is leaking back into the suction side of the system. In addition, we may also have a leaky discharge valve which will mean that as the piston is going down in the cylinder and we are reducing the pressure above the piston to a pressure lower than the suction pressure so that we can draw

in a fresh charge of gas, the leaky discharge valve may also allow some gas to enter the cylinder from the discharge line instead of from the suction line, which means that gas which we have pumped through the compressor leaks back as our piston goes down the stroke. All of these things then affect the volumetric efficiency of a compressor.

The speed at which a compressor runs will affect volumetric efficiency in two ways. If we have a very slow speed compressor the effect of leaks through suction or discharge valves or leaks by the piston will be especially pronounced. If the compressor runs at exceptionally high speeds the rate at which the gas passes through the valves is increased and the loss in efficiency due to throttling or wire-drawing action is especially noticeable.

Clearance Volume

In general, we try to keep the clearance volume as small as we possibly can and to that extent the piston moves up to within a very few thousandths of an inch of the compressor head and we try to keep the clearance volume through the discharge valve at a minimum.

Since we can keep the same clearance in a cylinder when we have a long stroke that we can a cylinder where we have a short stroke, in general the compressor having a long stroke will have higher volumetric efficiency.

Where we may have a compressor operating at 100 lbs. absolute head pressure due to a rise in condensing pressure caused by higher cooling medium temperatures, we will find that our head pressure is increased considerably and therefore we can expect to have a lower volumetric efficiency and move less gas to our compressor, decreasing the refrigerating capacity of the machine. This is largely the reason why water-cooled condensing units have a higher capacity for the same compressor speed than do air-cooled condensing units where we normally operate with higher head pressures.

If we were to use a compressor at 10 to 20 lbs. per square inch absolute suction pressure and we then determine its volumetric efficiency, we may reasonably expect that the volumetric efficiency wil be considerably higher when we use the same compressor at much higher suction pressures. In this instance we can expect to obtain higher volumetric efficiency in air conditioning work where we maintain high evaporation temperatures and consequently high suction pressures than we can in low temperature work.

We may also in considering the use of the refrigerant to be used in low temperature work take into account the volumetric efficiency of the compressor. If we want to evaporate a refrigerant at zero degrees using SO_2 we would have an absolute suction pressure of 10.35 lbs. per square inch and our volumetric efficiency would be low in comparison with methyl chloride which would evaporate at an absolute suction pressure of 18.7 per square inch absolute pressure.

At the same time, if we were to condense at 100° methyl chloride it would require 119 lbs. absolute pressure as a condensing pressure while SO_2 would only require 84.5 lbs. absolute condensing pressure so that the effect of the increased head pressure would offset to some extent the benefits of the increased suction pressure with regard to the volumetric efficiency to be secured from a compressor with methyl chloride in comparison with sulphur dioxide.

In general, however, the higher the suction pressure at which the refrigerant operates the higher the volumetric efficiency will be and the increased suction pressures in general more than offset the increased head pressures. Ammonia could be expected to show a higher volumetric efficiency for low temperature refrigeration then we could expect from "Freon," methyl chloride or SO_2 provided the compressors were designed with equal regard for clearance volume since ammonia operates at higher suction pressures than the other refrigerants named.

In repairing compressors it is important that we check the piston valves and head valves to see that they have sufficient opening and open freely enough so as to not cause too much drop in pressure through the valves which will cause a decrease in volumetric efficiency. It is also important, of course, to check the valves for possible leakage. The pistons should also be a good fit in the cylinders and should be properly provided with piston rings so as to prevent leakage by the piston.

Third Article on

AIR CONDITIONING

by W. C. Farmingdale

will appear in June

COPY being prepared for the third in the series of articles on Air Conditioning was not completed in time to include in this issue. This interesting series will be continued in June.

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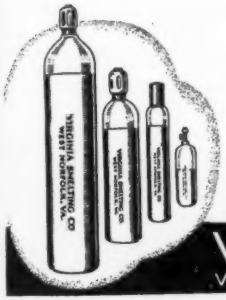
And she will, too, thanks to modern science. Among the many miracles of today, none plays a more important part in "making life easier" for the modern woman than automatic refrigeration, with its easy-to-make frozen desserts, ice-cubes, and other conveniences.



In this trouble-saving industry, Virginia Smelting has done its share to bring it to its present perfection. ESOTOO and V-METH-L are widely used as refrigerants by the leaders in the refrigerating field. The *purity and complete dryness* of these refrigerants insure trouble-free operation and lasting life. Both ESOTOO and V-METH-L are available for immediate delivery from 82 distributing points here and abroad.

VIRGINIA SMELTING CO.
WEST NORFOLK VIRGINIA

Electronics for Servicemen—Sixth Article

Continued from Page 30

so that the armature still revolves in a clockwise direction.

This is how a repulsion-induction motor starts.

Now once the armature is up to speed, the centrifugal weights fly outward and force the necklace collar and the necklace (short-circuiting device) against the commutator and thus short-circuit the armature windings. The armature now becomes the same as the squirrel cage armature on the capacitor or polyphase motor; that is, the armature is made up of a great number of short-circuited copper wires which are equivalent to the copper bars of the capacitor armature. Then the motor runs by induction as described under the capacitor motor.

Brush Movements

Now the position of the brushes have a marked effect on the starting torque of the motor. If the brushes are placed in the neutral position, the motor won't start. If they are shifted to one side of neutral the motor will run in one direction, if they are shifted to the opposite side of neutral, the motor will run in the opposite direction. If the brushes are shifted too far past neutral position, the motor will have a low starting torque.

Let's see how and why the position of the brushes affects the starting torque and the direction of rotation of an r.i. motor.

Consider Figs. 10, 10A, 10B and 10C. When the brushes are as in Fig. 10, the armature winding is parallel to the magnetic flux. Hence the magnetic flux does not cut any of the armature winding and no current flows in the armature. Thus the armature will not turn. This is called the *neutral position.* If the brushes are set as shown in Fig. 10A, all the flux will cut all the armature winding and a heavy current will flow in the armature. However, the motor *will*

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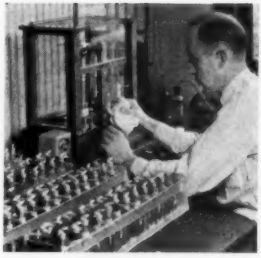

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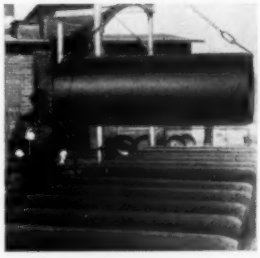
Ansul's range of cylinder sizes include everything from the six pound cylinder to the one ton drum. From the manufacturer who requires a large tonnage to the service man who wants only a few pounds for a particular job, every user will find a cylinder to fit his need.



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CHEMICAL COMPANY
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METHYL CHLORIDE

not start because the resultant magnetic poles on the armature are directly under the poles of the field. The armature will hang and vibrate when the brushes are in this position.

Now if the brushes are placed anywhere between these two positions, the armature windings will be cut by the magnetic flux. The resultant armature magnetism will be displaced from the field magnetism and the armature will revolve. How to locate the position of maximum starting torque will be discussed in an article entitled "Repairing Refrigerator Motors."

As stated above, the position of the brushes on either side of neutral position determines in what direction the armature will revolve. The reason for this can be seen by examining Fig. 13 and 13A. Notice in Fig. 13 that the field cuts the armature winding in the opposite direction to what it does in Fig. 13A. As a result the armature magnetism in Fig. 13 and 13A are reversed. Hence in Fig. 13 the motor rotates in a direction opposite to that in Fig. 13A.

S S S

R. J. Hill,
Rhode Island.

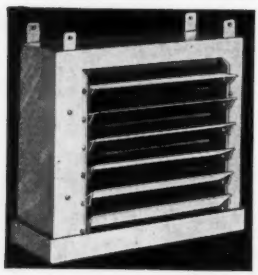
"A fine paper for any refrigeration man."

COMFORT IN THE DOGHOUSE

IT'S not so bad, being in the doghouse these days. At least if you pick the particular doghouse being built in Surrey, England, by the Greyhound Racing Association, where the pedigreed canines are to be housed in air conditioned kennels.

Nor are dog days felt in Phoenix, Arizona, where Nash-Kelvinator engineers have installed an air conditioned operating room for ailing animals. In order that there should be no hard feelings between pets and attendants, similar equipment for the staff was installed in the adjacent living quarters.

The dog is not the first to have his day of receiving the benefits of air conditioning. Last year, "Jerry," favored pet parrot owned by Mr. Sam W. Gumpertz, General Manager of the Ringling Brothers and Barnum & Bailey Circus, received especial attention at the hands of Kelvinator's Air Conditioning Division in the Gumpertz private car. Only recently a man in New Jersey became the proud owner of an air conditioned super-chicken-coop, where the Rhode Island Reds and the White Leghorns live in a style quite as doggy.



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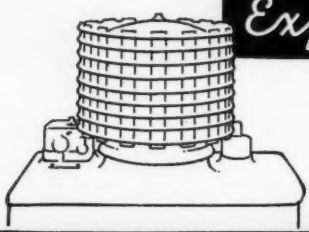

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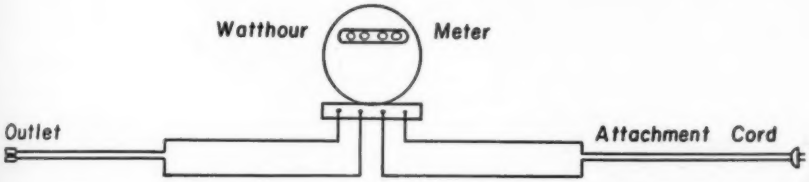
365 EAST ILLINOIS ST. — CHICAGO, ILLINOIS

How to Build a Watt-hour Meter

by F. V. GOLITZ*

A COMPANION instrument to the Running Time Indicator described in the March issue of THE REFRIGERATION SERVICE ENGINEER is a Watt-hour Meter mounted in a case and connected so that the instrument can be used to check current consumption of a domestic refrigerator without breaking any of the motor leads.



To use this instrument the refrigerator is plugged into the outlet at the top of the case and the instrument cord is plugged into the wall outlet. The reading of the meter in kilowatt-hours is noted, and after a period of a week or two the instrument can be read again; the first reading subtracted from the second reading gives the amount of current consumed by the refrigerator.

Material Needed

1 Watt-hour meter (preferably a 5-amp.), single-phase, 110-volt.
1 single flush outlet.
1 attachment cord and plug.
1 suitable case with carrying handle.

The meter is wired as shown in Fig. 1.

Outlet
Attachment Cord
Meter Watt-hour

The use of meters mounted in carrying cases gives a professional appearance to the serviceman and enables him to obtain greater returns for his work.

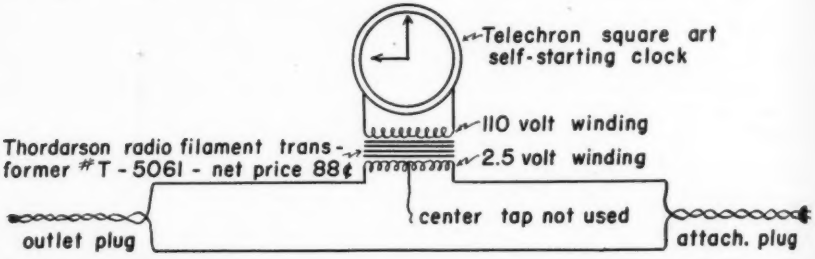
*Instructor Electric Appliance Dept., Allegheny Vocational School, Pittsburgh, Pa.

Revised Wiring Diagram of Running Time Indicator

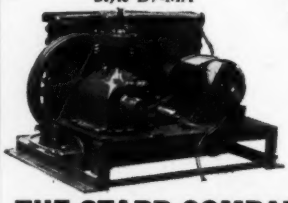
By F. V. GOLITZ

CONSIDERABLE interest has been shown in the article describing the Running Time Indicator, appearing on pages 20 and 21 of the March issue.

After experimenting for a simpler method of coupling the clock in this instrument, Mr. F. V. Golitz, the author, writes: "We developed the method shown in the above diagram. The relay is replaced by an inexpensive radio filament transformer. Almost any make of transformer will do. Use the 2.5-volt, 3-ampere winding in series with one side of the line. The clock is connected across the 110-volt winding. When the unit is started by the thermostat, the current flowing in the 2.5 winding induces a current in the 110-volt winding, this will operate the clock."


Telechron square art self-starting clock
110 volt winding
2.5 volt winding
Thordarson radio filament transformer # T - 5061 - net price 88¢
center tap not used
outlet plug
attach. plug

Condensing Unit Style D7-MA



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REFRIGERATION SERVICE ENGINEERS' SOCIETY

Official Announcements of the activities of the National Society and Local Chapters appear in this department as well as articles pertaining to the educational work of the Society.

ASSOCIATION HEADQUARTERS: 433-435 North Waller Ave., CHICAGO, ILL.

CHICAGO CONVENTION PLANS

CHICAGO Chapter is actively engaged in planning for the 4th Annual Convention. Committees have been appointed and have started work in preparing for the larger attendance anticipated for this important event of the refrigeration service business.

Space plats, showing the exhibit space available, have been mailed to manufacturers of various refrigerating equipment. It is anticipated that over sixty exhibits will be represented at the Chicago Convention. Plats may be secured from the National Headquarters Office.

4th Annual Convention
Stevens Hotel, CHICAGO
November 3, 4 and 5

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Keep in good standing. Don't miss any educational material or your official organ.

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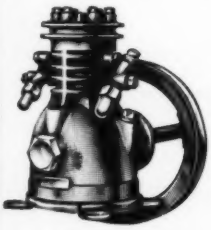
NIAGARA FRONTIER CHAPTER

Meeting of March 25, 1937

By GEORGE E. WILSON, *2nd Vice-President*
92 Royal Ave., Buffalo, N. Y.

AT the meeting held on the evening of March 25th, President D. B. Schuster announced that through Mr. H. C. Mabie



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are designed to give you many years of quiet, efficient and trouble free service by Engineers who have been serving the refrigeration industry for the last fourteen years.

They have again "scored a hit" with a new "V" type four cylinder compressor which is designed for use with ½ to 1 HP motors. All of the advanced features that have proven so successful in "Chieftain" household and light commercial units are now incorporated in this new four cylinder model.

Mechanical improvements include, force feed lubrication to piston pin and connecting rod bearings, positive alignment of cylinder bores with main bearings by casting cylinders and crankcase in one piece. Adjustable suction shut-off valve, interchangeable parts with single and twin cylinder models. All compressor parts are machined to precision limits on up to date equipment and assembled in glass enclosed rooms where only filtered, dust free air is admitted.

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TECUMSEH PRODUCTS CO., Refrigeration Division TECUMSEH, MICH.

of the Educational Entertainment Department of the Chevrolet Motor Division of General Motors Sales Corporation, Mr. George Wilson, acting Educational Director under the chairmanship of Mr. Joseph Askin, chief engineer of the Fedders Manufacturing Company, had secured a program which would precede the regular business meeting. Following this announcement, Mr. Schuster introduced Mr. John Sandstone of the Educational Entertainment Division, Chevrolet Motor Division of General Motors Sales Corporation of Buffalo and Mr. P. F. Mider of the same division at Detroit who showed sound films of general interest.

At the end of the entertainment feature a rising vote of thanks was extended to Messrs. Sandstone and Mider and the educational director took over the meeting. Mr. Wilson outlined the policies of the educational committee in that they were endeavoring through open forum discussion to bring out and develop members who ordinarily attend meetings without entering into any of the discussions. Likewise, he stated that he hoped in the near future to present to the members a bulletin which would contain the educational program for the ensuing year and which would include not only the open forum discussions but the programs to be put on by the various manufacturers who were concurring with the committee in forming this program. He suggested that the members should by motion decide whether or not the chapter would hold meetings in the summer so that the Educational Committee could be guided by their decision.

At the end of this talk by Mr. Wilson, Mr. Walker, the secretary, read the call of officers and the minutes of the last meeting. Mr. Schuster, upon taking charge of the meeting, said that he had turned over to the Educational Committee a list of firms which he had received from our National Secretary, H. T. McDermott. This list had been compiled from those manufacturers and dealers who were willing to put on an educational program for the various chapters and he stated that he thought the suggestion made by Mr. Wilson relative to the question of meetings should be decided at that meeting.

After a discussion, pro and con, on this matter the general consensus of opinion was that the chapter would hold regular meetings throughout the year. However, as the summer attendance at meetings would no doubt be small, motion was made by Mr. J. C. Kerns and seconded by Mr. E. Benz that

CATALOG No. 11

Parts — Tools — Supplies — Equipment

INTRODUCES

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regular meetings be held throughout the year, the last meeting to which the manufacturers were to be invited to participate being the first meeting in June. The regular open forum type of educational program to be conducted through the summer months and that concurrence on the part of manufacturers be resumed at the last meeting in September. This motion was carried.

Mr. George O'Hara, chairman of the Entertainment Committee, made a special plea to members to fulfill their promises that they had made at a previous meeting for prize donations for the Card and Bingo Party to be held April 14th. He pointed out in particular the outstanding efforts of Mr. and Mrs. Weise in the collection of some ten or more prizes, stating that it was a mark that everyone should try and attain. He likewise spoke on the advisability of having a program made up for the annual banquet, soliciting advertisements from the various companies associated with the organization activities. He extended an invitation to all committee members to meet at his home on the evening of April 9th as this meeting would precede the card party by one week and final arrangements could be made as well as a check-up on prize donations, ticket sales and the activities of the various committees for the evening and the party.

A motion was made by Mr. Wilson and seconded by Mr. Ray Parsons that a vote of thanks be extended to Mr. and Mrs. Weise for their splendid cooperation with Mr. O'Hara. This motion was carried.

Mr. E. Benz suggested that there should be more activity in securing new members and that an active membership committee be formed. After considerable discussion on the subject, Mr. Wilson suggested a membership drive of the competitive type and that a prize be given to the member securing the most new members. As this seemed to meet with the favor of the members present, Mr. Wilson put this into motion form. It was seconded by Mr. Benz and passed. Mr. O'Hara as a special incentive in a three-months' drive for members, donated a set of gages to be given to the member bringing in the most new members. He was followed in turn by Mr. Schuster who donated a snap-on valve key. Mr. Wilson donated a refrigeration service drum, Mr. Benz donated a minor motor repair up to and including 2-h.p.

Mr. O'Hara made a motion limiting the prizes to active new memberships and mak-

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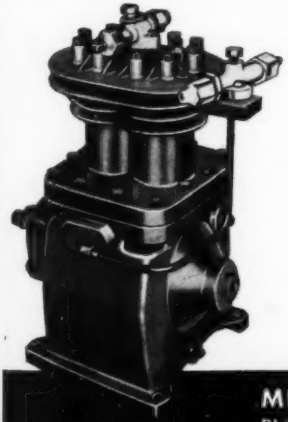
for All Standard ICE CREAM CABINETS



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ing the donators of the prizes non-eligible. This was seconded by Mr. Wilson and passed. Mr. Walker, the secretary, was instructed by Mr. Schuster to send a letter to all members advising them of the membership drive and the prizes to be awarded.

ONTARIO MAPLE LEAF CHAPTER HOLDS DANCE

AFTER a great deal of work on the part of the Entertainment Committee, and with the cooperation of the membership, the first annual dinner-dance of the Ontario Maple Leaf Chapter was held on Wednesday evening, March 31st, at the Savarin Hotel on Bay Street, Toronto.

After dinner, dancing and cards were the order of the evening, and were enjoyed by all. Prizes were awarded at the card game and two special prizes were drawn for at the dinner table. The lucky ladies were Mrs. James Spence and Mrs. J. H. Stoliker, both of Hamilton, and Mrs. Don Tanner of Niagara Falls, and the lucky men were Mr. T. W. Shaw and Mr. W. M. Madill of Toronto, and Mr. Ramsden of Hamilton.

The evening proved to be a success socially as well as financially, and a bigger and better program is planned for next year.

INDIANAPOLIS CHAPTER

Meeting of April 13, 1937

By E. R. CLAUS, *Secretary*
815 S. Delaware, Indianapolis, Ind.

THE meeting of Tuesday, April 13th, was held at the Lincoln Hotel, with President Wm. L. Drake presiding. The Secretary read the minutes of the last meeting, followed by roll call which showed thirty present.

Mr. J. A. Cassady of the F. H. Langsenkamp Company introduced Mr. H. S. Dekker of Chicago, who is taking charge of the sales in their refrigeration department. Mr. Dekker gave the members present a very interesting talk on his experience with chapters. He also gave some very interesting points on how we will be able to get a license law in effect here in Indianapolis. Mr. Dekker was given a big hand and invited to attend our meetings as often as possible.

President Drake and his partner, Mr. R. C. Robinson, had received some fish from the Ansul Chemical Company and it was decided to hold a fish fry. President Drake appointed Secretary Claus to assist him with

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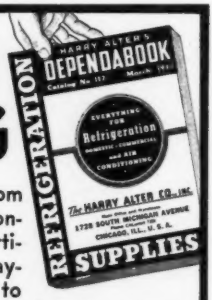

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arrangements for the fish fry. The date set was April 15th.

Mr. Cassady made a motion to check up on ways and means to get a license law in effect. A vote was taken and passed. President Drake announced he would call the officers and directors of Indianapolis Chapter together before our next meeting to formulate plans for a license code to be used here in Indianapolis.

S S S

TWIN CITIES CHAPTER

Meeting of April 13, 1937

By **A. M. PALEN,** *Acting-Secretary*
3557 43rd Ave., S., Minneapolis, Minn.

PRESIDENT A. E. JOHANSEN announced that Mr. J. Samways, our secretary, is now located outside of the Twin Cities and that his office had, therefore, been vacated. Nominations were made to select a secretary to replace Mr. Samways. Mr. W. V. Warner, A. G. Larson and C. E. Tupper were nominated for the office. It was brought out that these three nominees already held offices as vice-president and members of the board of directors, so the nominations were declared void. Mr. Art M. Palen was appointed acting-secretary pending the election of another secretary.

Mr. Spotsworth of the Minneapolis Fire Prevention Bureau was introduced and discussed the code governing refrigeration installation in Minneapolis. He invited our members to call on him for discussion on the code at any time we desire and permission to consult their association in the event any changes in this code were contemplated.

After some discussion it was decided to continue holding regular meetings during the summer months.

S S S

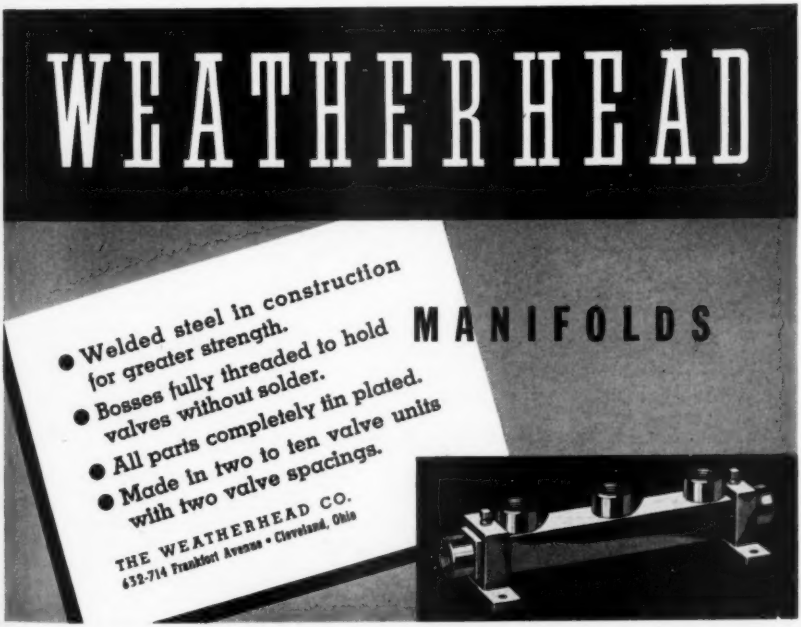
CENTRAL INDIANA CHAPTER

Meeting of March 30, 1937

By **PAUL JACOBSEN,** *Secretary*
R. R. 1, Marion, Indiana

THE meeting which was held at the Hotel Sidwell in Anderson, was called to order by President Vern Nold.

Mr. K. V. Anderson, sales engineer for Mills Novelty Company of Chicago, gave a talk on the Mills refrigerating compressors and spoke at length on the many improvements which have been made in machines today. Mr. Anderson also answered many questions asked by the members.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Secretary Paul Jacobsen spoke on the progress of the Society, and two new members were taken into the organization.

Meeting of April 13, 1937

This meeting was held at the Y.M.C.A. at 12th and Jackson Streets, Anderson, Indiana, and was called to order by President Vern Nold.

Discussion started on which name would be the most suitable for the chapter, and after many suggestions the name Central Indiana Chapter was adopted.

The question box had been loaded and the entire evening was spent discussing the various questions which all concerned the everyday problems of a service engineer. All the members participated in the sometimes heated discussions and it was generally agreed that a very profitable evening had been enjoyed by all.

A suggestion was made that small stickers be made and that every service engineer should place these on the machines they work on.

Mr. R. H. Morris requested that every member of the chapter be furnished a list of all the other members in the chapter.

It was decided to hold the next meeting in Marion on April 27th. Meeting adjourned at 11 P.M. and the members retired to partake of refreshments at a nearby restaurant.

Meeting of April 27, 1937

This meeting was held in Marion at the Indiana General Service Co., who provided one of their beautiful meeting rooms.

It was decided that the charter be closed on May 4th at our next meeting inasmuch as a sufficient number of members are on the rolls now.

The question box is gaining in popularity and the members seem to have so many questions to ask and discuss now that a very profitable evening is spent discussing our everyday problems alone.

PITTSBURGH CHAPTER

Special Meeting of March 22, 1937

By F. V. GOLITZ, *Secretary*
1109 Pemberton St., Pittsburgh, Pa.

THE meeting was held in the auditorium of the Electric Products Corp. at 5624 Penn Avenue, and was opened with the introduction of Mr. H. A. Schreiber by Pres-

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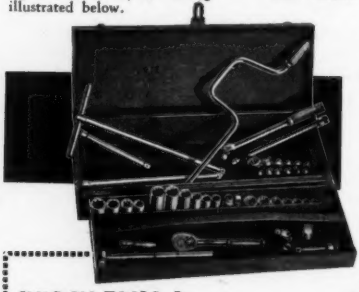

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• Better service begins with this No. 82 Snap-on Ferret Set. The long slender units, like the Ferret, squeeze into the closest places to spin nuts on or off . . . also, like the Ferret, they are twice as strong as you'd expect—light, easy to handle, fast in action.

When you're rushed . . . hurrying from one service job to another, Snap-on's Specialized Refrigeration Service Tools will get you around on time, and you'll finish every job on a single call. Get these time-saving tools now . . . and be all set for the heavy summer season.

Available only through our own branch distributing warehouses located in 37 principal cities. See Snap-on Tools, Inc., in your telephone directory or send coupon.

ident John Kirch. Mr. Schreiber welcomed the service men and pointed out the many services offered by his company and Frigidaire. He then introduced Mr. N. Alexander, who conducted the educational part of the meeting.

Mr. Alexander's talk was illustrated with charts. The subjects covered were compressor ratings, liquid control valves, operation of direct expansion systems and low-side float systems; also a discussion of forced draft cooling units. This was followed by the answering of many questions on commercial applications of Frigidaire valves.

The meeting was then turned over to Mr. C. W. Lane, who talked about the policy of the Electric Products Company as to the merchandising of parts. He also introduced Mr. Hammond and Mr. Dugan, who are in charge of the parts department.

President Kirch thanked Mr. Schreiber and his associates for the fine program they had presented and the meeting was adjourned with the serving of refreshments.

Meeting of April 12, 1937

The regular April meeting of the Chapter was held in the Commonwealth Building on Monday, April 12th, with about fifty members and visitors present. President John Kirch presided.

President Kirch introduced Mr. C. W. Thorn of the Kramer Auto Radiator Company who in turn introduced Mr. A. Kassatz of the Tagliabue Company. Mr. Kassatz gave a step-by-step story of the building of a Tag Control. The test methods and setting of the cut-in and cut-out points were also discussed at length. At the conclusion of the talk, Mr. Kassatz answered many questions on the service and application of Tag Controls and Water Valves.

President Kirch reported on a meeting he and Secretary Golitz had attended. This meeting was sponsored by the Servel Company and featured Mr. Larry Terhune, their eastern sales manager. Mr. Terhune's forceful manner and convincing talk won many new friends for Servel.

Mr. H. S. McCloud invited the chapter to participate in a meeting sponsored by the Williams Company to be held on Monday, May 10th, at which representatives of the Alco Valve Company and the Henry Valve Company will lecture and demonstrate their products. Motion was made by Mr. Barbagallo and seconded by Mr. Ross that the

RENEWABLE SEAT

Here is an Automatic Expansion Valve with remarkably long life . . . one you can install and forget. Fast-moving gases simply cannot score or pit it. The non-metallic, corrosion-proof poppet and seat require little or no servicing . . . are readily renewed when necessary, at little cost, by the service man. This poppet construction and other exclusive features of design make the Sylphon Valve your logical choice. Ask for Bulletin V-5000.

FULTON SYLPHON COMPANY
Refrigeration Division
KNOXVILLE TENNESSEE

Sylphon TRADE MARK

AUTOMATIC EXPANSION VALVE

invitation of Mr. McCloud be accepted, and was carried unanimously.

President Kirch reported that twelve wives of the members present were meeting in the Secretary's home as the guests of Mrs. Golitz for the purpose of organizing a Ladies Auxiliary, and that any of the members desiring information should communicate with the Secretary.

YOUNGSTOWN CHAPTER

Meeting of April 19, 1937

By MARTIN BOKESCH, Jr., *Secretary*
R. F. D. 5, Youngstown, Ohio

PRESIDENT M. W. BOKESCH opened the meeting, followed by roll call, reading of the minutes of the last meeting and the Treasurer's report.

Motion was made and carried that the Treasurer send a check to the National Secretary for per capita tax for the members who had paid.

Decision was made to hold only one meeting a month during the months of June, July and August—to be held on the first Monday of each month.

Messrs. Martin Bokesch, Jr. and Roy Keith were appointed to act as a committee in arranging plans for the holding of a dinner party on May 17th.

This committee was also appointed to make arrangements for a get-together stag party to be held for the members and their friends on Saturday, May 1st.

KANSAS CITY CHAPTER

Meeting of March 23, 1937

By R. E. KINGSOLVER, *Secretary*
3830 Woodland Ave., Kansas City, Mo.

THE meeting was called to order by President H. L. Green. Roll call of officers and members revealed fifty-four present.

President Green reminded the members of payment of their dues.

Special letters from the Wolverine Tube Company and National Secretary H. T. McDermott.

The following members took the membership oath: Messrs. Scofield, Bragford, A. H. Ross, Hoover, and Via.

Mr. Thompson of the Alco Valve Company was the speaker of the evening. He brought with him slide pictures and a refrigeration unit with a glass tubing coil to assist him in his lecture, which all together proved very interesting.

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COMPRESSORS

★FOR COMMERCIAL USE

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4100 Fullerton Ave., Chicago, Ill.

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ST. LOUIS CHAPTER

Meeting of March 25, 1937

By E. A. PLESSKOTT, *Secretary*
2145 67th St., St. Louis, Mo.

THE regular meeting of St. Louis Chapter was held at the German House and was called to order at 8:30 P.M. by President E. Gygax. The minutes of the March 11th meeting were read and approved, and in the absence of Mr. O. G. Tinkey, our speaker was introduced by Mr. Gygax.

Crosley Service

Mr. Al. Krispin, service engineer for the Stanley Distributing Company, Crosley distributors for this territory, gave a most complete story on the servicing of these refrigerators. Questions were many and varied, and at the conclusion of his talk there were some additional questions on ice cream cabinet servicing and Majestic refrigerator service.

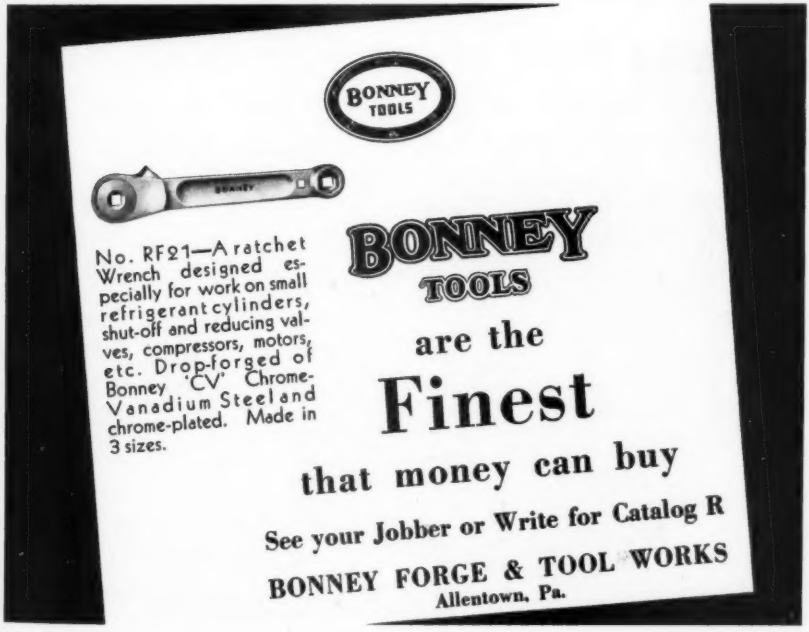
Mr. G. J. Wangerin, head instructor of the refrigeration class at the David Ranken, Jr. School of Mechanical Trades, and a member of this chapter, invited us to attend some meetings at which they have promise of some outstanding authorities in the refrigeration field. Also, in the near future, he would like us to hold one of our regular meetings there and see some of the new gadgets he has rigged up for class instruction. It was decided to accept this offer and in the event the speakers should come on a night other than our regular meeting night the Secretary is to notify the membership by calling a special meeting or inviting them to attend.

An application for membership for Mr. Chas. Ott was referred to the Committee.

Meeting of April 8, 1937

Our speaker of the evening, Mr. M. G. Johnson of the Triox Engineering Company, being confined to bed and unable to attend, President Gygax assisted by Mr. A. H. Huhn, gave a very interesting demonstration of a quick and simple method of testing various kinds of water to ascertain the degree of hardness. It was shown by example just how much accumulation accrued for a given hardness and how a simple and effective method of elimination could reduce this and keep the equipment functioning 100%.

Mr. Tinkey advised those present that the next meeting would probably be at the Ranken School and should prove most interest-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No. RF21—A ratchet Wrench designed especially for work on small refrigerant cylinders, shut-off and reducing valves, compressors, motors, etc. Drop-forged of Bonney 'CV' Chrome-Vanadium Steel and chrome-plated. Made in 3 sizes.
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TOOLS
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See your Jobber or Write for Catalog R
BONNEY FORGE & TOOL WORKS
Allentown, Pa.

ing. The Secretary advised all to be sure to get there on time since school regulations require classes to start at 7:30 and close at 9:30, and in order to take full advantage of this offer we shall need every minute of the time available.

Mr. Tinkey read a few paragraphs from his latest A.S.R.E. magazine to show what "ozonation" will do, and judging from these excerpts there should be a very large field for its application. He promised to keep in touch with Mr. Johnson and have him up to an early meeting.

An application for Mr. R. S. Detweiler was read and referred to the committee. The Secretary exhibited the new R.S.E.S. decalcomania transfer and advised those present he would be glad to order as many as were wanted.

TWIN CITIES CHAPTER PLANS DANCE

ARRANGEMENTS are being made for a dance to be given by Twin Cities Chapter of St. Paul and Minneapolis for the chapter members, their families and guests. Tentative plans establish the date as sometime in May.

Mr. H. W. Small of the Thermal Service Company is the chairman in charge of the arrangements. Tickets will be available to non-members of the Society who are in the refrigeration business, through members of the Twin Cities Chapter.

VIEWS AND REVIEWS

By HERMAN GOLDBERG

THROUGH periods of bad times due to the clamor put up by desperate unemployed labor, new legislation is always put into effect to avoid repetition. Also, due to low wage schedules effective in various plants during bad times, employees are more open to agitation upon the first signs of business recovery for immediate increased wages regardless of how long they may have been living under sub-par conditions.

It is interesting to note that strikes or prospective strikes during the past few weeks have been settled in shorter time than were complaints or actual strikes earlier this year. I believe the reason for these early settlements is because both labor and capital as represented in the various controversial plants recognize that they both lose

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is light! Fits perfectly with one adjustment to wearer. Effortless breathing, and no clouding of lenses or reinhalation. On and off in a jiffy—and always SAFE. When in place this mask constitutes a perfect seal. Comes in compact, sturdy case, with cartridges for gases commonly encountered in refrigeration work.

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through lack of fair arbitration and the longer a strike continues, naturally the more costly it is not only to the employer but to the individual employee.

It is my thought that not only through settlement of current strikes through the recognition of the above facts, but also through a period of time when there shortly will be a minimum of strikes, that employed labor in itself, which always acts as a fine medium for the movement of currency, will create the most tremendous purchasing or buying era which this country has ever seen, and through this movement will create enough demand for all products so that big business, regardless of its fear of legislative activities, will be working full blast.

Proof of the effects of strikes on small business is actually seen in the slump of activities which has been felt for the past month to six weeks by organizations which, up to that time, were steadily gaining in business. With the tremendous number of people voluntarily out of work through strikes, and the tightening of big business through strikes and legislative activities, small business, regardless of how remote the sources of trouble, has suffered.

The salvation of the entire situation appears to lie in the fact that regardless of how long or how much men might be agitated into striking at some time or other, their small capital necessary for ordinary living expenses runs down to the point where they cannot borrow any more, or perhaps, receive sufficient federal relief and they must go back to work. On the other hand, insofar as the fears of big business are concerned, it appears to me that there are always large companies which benefit or lose to some extent by legislative acts.

It stands to reason that in the matter of strikes large companies suffer financially at least in a multiplied relative degree to the individual employee out of work. Although labor will not gain all its demands, general wage increases are steadily going into effect. Well paid labor always in the past has paid higher prices for its multiple purchases.

FLASH—Chicago Chapter is to be highly complimented on the splendid work and regalia of their degree team. Hats off to Ralph Vanston, George Monjian and the rest of the boys. Harry Logemann's feet are big enough to mark him as a regular flat-foot policeman.

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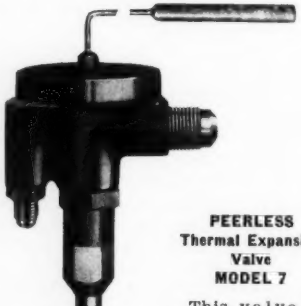
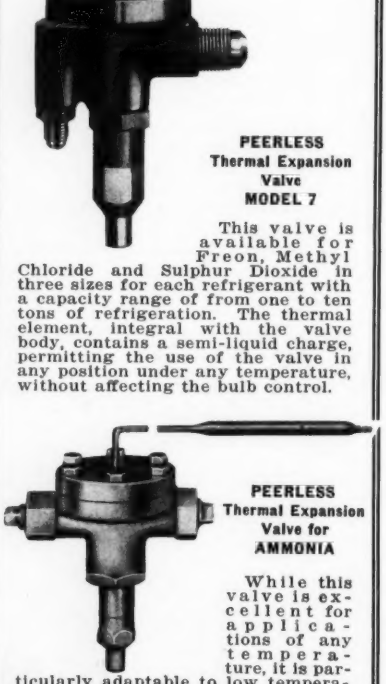


PEERLESS
Thermal Expansion
Valve
MODEL 7

This valve is available for Freon, Methyl Chloride and Sulphur Dioxide in three sizes for each refrigerant with a capacity range of from one to ten tons of refrigeration. The thermal element, integral with the valve body, contains a semi-liquid charge, permitting the use of the valve in any position under any temperature, without affecting the bulb control.



PEERLESS
Thermal Expansion
Valve for
AMMONIA

While this valve is excellent for applications of any temperature, it is particularly adaptable to low temperature work. Ball type seat insures positive closing and full opening of valve. Capacity up to 5 tons.

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Est. 1912 as The Peerless Ice Machine Co.

Main Factory—General Offices
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Pacific Coast Factory
3000 S. Main St.
LOS ANGELES

THE "CONTRIBS' COLYUM"

By THE KINGFISH

SO a guy calling himself "the Rambler"—meaning passing from one thing to another without order or method—is muscling in on the "colyum" racket. Wonder if he is the forlorn son of the Buckeye State.

—

Speaking of Buckeye, we hear that Paul Jacobsen presented the Charter to their latest addition—Columbus Chapter—on Tuesday April 27th.

—

We also hear that Chicago Chapter has appointed Herman Goldberg Chicago Convention Committee Chairman, and that he has nearly all of his committees lined up with real men at the head of each.

—

Did you read the very fine talk presented by H. C. Rethwisch at the St. Louis Chapter meeting of February 25? If you did not read it then turn to page 39 of April issue of the REFRIGERATION SERVICE ENGINEER.

—

How does it feel to be a "Poppa," Willis Stafford?

—

June Brunton lost 10 lbs. during the flood—she carried all Claude's supplies and tools upstairs when the flood waters reached their shop. Claude was busy moving machines for his customers. Atta girl, June.

—

We wish Mrs. George O'Hara lots of luck as chairlady of the Ladies' Auxiliary of the Niagara Frontier Chapter.

—

There is a rumor going around that Harry DeGan is going to build a new home and that "Kate" is going to be the designer, interior decorator and general architect. Oh, boy, what a house that will be.

—

Something happened to George Monjian at the last stag party of the Chicago Chapter. What was it?

—

Wonder if Buschkopf, Wang, McLaughlin, Gugler and all the other Wisconsin men are still snowed in. We haven't heard much from that neck of the woods for a long time. Or do they hibernate? We read about some Wisconsin man who did that every winter; went to bed in November and up again next April.

You have to give Kelvinator credit for changing the old rule that no one but a Kelvinator agent can buy parts from them. Now we can all buy genuine Kelvinator parts through our regular jobber. Others will follow soon we believe.

—

Heard from McCauley the other day—he outlined the prizes to be given to the various chapters on the basis of proportionate increase in their paid up membership at the end of June, 1937. Every chapter has an equal chance to win a prize this time. Who will get the grand prize this year?

—

The new decalcomania emblem of the society is a fine piece of work and we can hardly wait until they arrive so we can put them on the sides of our car.

—

Appears that Steve Leitner and his gang had a "swell" time at their annual banquet last month. Judging by the looks on the boys' faces it must have been a good looking "birdie" they gazed at while the picture was taken.

—

Mississippi Valley Chapter of Davenport and vicinity has added two new members to their group. They are Mr. Russell Miller and Mr. A. D. Stivers, both of Galesburg, Illinois.

Mr. Leonard Nelson, vice-president of the chapter, was quite an acrobatic performer at the Stag which was an event following the last meeting.

Mr. Clarence Teagarden is slated to be Master of Ceremonies at the next stag or party of the Chapter.

* * *

"CHANCO" HIGH SIDES

THE H. Channon Company, Chicago, Ill., distributors of the already famous "Chanco" refrigeration machines have increased their stock so that any model or size may be delivered the same day as ordered. These refrigerating machines are built to our specification by one of the oldest and largest manufacturers in the United States. The machines embody every modern improvement in this type of product and will meet the most exacting demands. The series ranges in capacity from ½ to 20 tons, designed for self contained applications to remote installations.

All models are of the multiple cylinder reciprocating type with sealed crankcases.

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for 3 WEEKS

Typical of the extreme precautions taken to eliminate every possible cause for service failure, is the *torrid aging test.*

Every A-P Thermostatic Expansion Valve is rigidly tested as an assembled unit. Each valve surviving this test is then given an aging test of three weeks in a room at 110 degrees, after which it is again tested under pressure of 400 pounds. This is why no A-P Thermostatic Expansion Valve has ever been returned with a broken diaphragm.

Complete range of sizes up to 15 tons Freon capacity.

Thermostatic Expansion Valve Model 220-K

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1. Small volume displacement per unit of refrigeration permitting the use of small, compact equipment.
2. Not corrosive to ordinary equipment.
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5. Gives controlled low temperatures easily and efficiently.
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Methyl Chloride for Service Work

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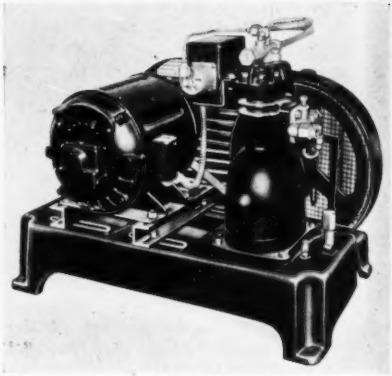

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Copper lead bearings and high efficiency valves insure long life and freedom from service expense. The forty distinct models afford an exact fit for every type of commercial refrigeration or air conditioning duty. All parts are fully covered by the manufacturer's warranty against defect for one year. All models are suitable for use either with methyl chloride or Freon. Also, a complete line of standard compressors is offered for replacement purpose, or for rebuilding obsolete types of equipment.

The Channon Co., are jobbers of a complete line of refrigeration supplies.

TRENTON AUTO RADIATOR ISSUES NEW BULLETIN

BULLETIN No. 437C—the first in a series of four proposed bulletins by the Trenton Auto Radiator Works, Trenton, N. J., manufacturers of Kramer refrigerating equipment—features complete recommendations for walk-in coolers of every size.

In this bulletin is contained pertinent data on the new streamline all-copper coils, Temperator combinations and Kram-R-Fin unit coolers. The purpose of the bulletin and its arrangement is to provide for instantaneous selection of low-side equipment.

The bulletin is 8½ by 11 inches in size, with illustrations of the various equipment described. The other Kramer bulletins, which are now on the press and which will be released shortly, include walk-in cooler equipment fabricated from copper and aluminum, complete unit cooler recommendations and engineering data and all-steel coils of galvanized finish for ammonia service.

PEERLESS OFFERS LARGE LINE OF VALVES

PEERLESS OF AMERICA, Chicago, Ill., formerly the Peerless Ice Machine Co., has added several new valves to its line this year with the intention of making available to its customers a complete line for use with all Peerless refrigeration products.

Two larger sizes of the Model 7 series of Peerless Thermal Expansion Valves, are now available, making a total of three sizes each of this model for use with "Freon," methyl chloride, and sulphur dioxide, with capacity ranges of from one to ten tons.

The new Model 70 Thermal Expansion Valve is designed primarily for use in air conditioning installations and commercial refrigeration plants with capacities of ten tons or more. This valve is made for use with "Freon" with a rated capacity of from ten to twenty-five tons, and for methyl chloride with capacity of from ten to thirty-five tons. The unusually large diaphragm area of this valve insures accurate control.

The Two-Temperature valve is another newcomer to the Peerless line. This valve is used where two or more coils requiring different temperatures are operated from the same compressor and is located on the suc-

KRUPP WATER REGULATOR

for Methyl-Freon-Sulphur

A regulator featuring elimination of the stuffing box. Water valve body is made of cast bronze and has renewable rubber composition seat; noiseless in operation; the frame is so designed that adjustments can be made easily. Operating range from 50 to 120 lbs.

Bulletins and prices upon request.

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Manufacturers of Krupp Valves for Mechanical Refrigeration

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you keep it right

● **The finest automobile engine is not built more painstakingly than a Copeland refrigerating unit.**

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To enable our authorized distributors or parts representatives to give quick service, we maintain complete stocks, ready for immediate shipment.

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BURSTEIN-APPLEBEE CO.
1012-14 McGee St., Kansas City, Mo.

tion line of the higher temperature unit. A calibrated pressure scale makes adjustment of this valve an easy matter.

The final addition to the Peerless Valve line is the retarder valve. This valve maintains a given cooling unit at a differential pressure as compared to a common suction line pressure, therefore allows this cooling unit to operate at a higher temperature over its entire surface.

The Peerless Thermal Expansion Valve for ammonia, while not new to the line, is a popular item. This valve has a capacity of up to five tons.

* * *

ANSUL CHEMICAL ISSUES HOUSE ORGAN

THE first issue of the Ansul News Notes, a house organ issued by the Ansul Chemical Co., has just been received.

The editor, in his brief editorial, outlines the contents of the Ansul News in the following manner: "A bit of this and that—running the gamut from the lowly story that is supposed to be funny to the high-brow article direct from our research laboratory staff."

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ICE MAKERS
WATER COOLED CONDENSERS

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BONNEY ISSUES 1937 TOOL CATALOG

PRINTED in the convenient pocket size, 5 by 7 inches, and containing 64 pages and cover, Bonney Forge & Tool Works, Allentown, Pennsylvania, has just issued Catalog No. 137 covering their full line of hand tools.

This book illustrates and describes in detail the full Bonney line of sockets with de-

tachable handles and attachments in all size drives, as well as special sockets, crowfoot attachments, solid socket wrenches, box wrenches, open end wrenches including engineers, tappet, "S" and angle head service types, electrical and ignition wrenches, miniature open-end and box wrenches, pump packing nut wrenches, Stillson wrenches, special sockets and tools for electric refrigeration service work and a full line of punches, chisels, pliers, screw drivers and hammers.

One of the features of this book is the unusually large line of wrenches which has been developed for specialized applications.

S S S

A. R. Olmsted,
Pennsylvania.

I have not yet received the April issue of THE SERVICE ENGINEER. As I look for every issue, I do not want to miss a copy.

PRACTICAL
Recording Thermometers
Motor Operation Recorders
are the service engineer's best trouble shooters

• The low cost of these portable, recording instruments means you can afford to use them. Try one under our 15 Day Trial plan. Note these Practical features: Portable, strongly built. Give 24 hour record in ink. Mechanism built into door, so it swings out of harm's way when changing charts. Carrying case, 25 extra charts, bottle of ink furnished free. Write today for folder showing prices and 15 Day Trial offer. Address: Dept. G.

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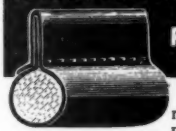
PRACTICAL Recording Thermometer
PRACTICAL INSTRUMENT COMPANY, 9717 N. ASHLAND, CHICAGO

DENNIS GASKETS
FOR ALL MAKES REFRIGERATOR DOORS



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GENERAL ELECTRIC, WESTINGHOUSE, MAJESTIC, GIBSON-HERMETIC UNITS REBUILT OR REPAIRED

A complete MACHINE SHOP SERVICE on all makes of both domestic and commercial units. All units completely tested and guaranteed. Write for our latest price list.

ALLIED REFRIGERATION PRODUCTS CO.
1947 Flushing Avenue Brooklyn, New York

Different! Handy! Quick!

Ideal Thermo Grip Pliers

Can't be beat for sweating threadless copper pipe fittings and all solder joints. No fuel to carry—no open flame. Easy to use in awkward places. Heats both sides and draws current only when in actual contact with object.

Heats quickly, makes soldering job fast, safe and economical.

Recommended by leading copper pipe manufacturers

IDEAL COMMUTATOR DRESSER CO.
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KRAMER COIL PRODUCTS

—A Complete Line

Send for Catalog

TRENTON AUTO RADIATOR WORKS

TRENTON, N. J.

Kramer Auto Radiator Corp. New York, N. Y.
Kramer Auto Radiator Co. Pittsburgh, Pa.

JOBBER OPENS IN MILWAUKEE

THE Thermal Company, Inc., wholesale distributors and jobbers of refrigeration and air conditioning equipment, automatic controls, refrigerants and specialties, has just announced the opening of its store at 925 West Wells Street in Milwaukee, Wis.

According to Mr. C. E. Hamilton, general manager, a catalog illustrating and describing the extensive line of merchandise carried in stock is now being prepared and will be ready for release in a few days. This catalog will be mailed to all firms active in the refrigeration and air conditioning industries in Wisconsin, Minnesota and other states in the northwest territory.

Mr. H. W. Small, president of the company, plans to make the Thermal Company Wisconsin's outstanding parts house, says Mr. Hamilton. Mr. H. Tangen, better known by the trade as Harvey, will be in charge of the city sales desk.

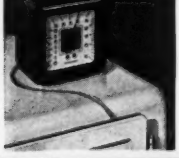
S S S

KEROTEST PERSONNEL CHANGES

THE Kerotest Manufacturing Company of Pittsburgh, has announced the transfer of Mr. Albert H. Fine to the New York office to assist Mr. K. M. Newcum, direct factory representative of the company in that territory. Mr. Fine has been connected with the Kerotest Company at Pittsburgh in the engineering and sales department during the past year.

Mr. George R. Postlewait, located at 333 Atlanta Ave., Webster Groves, St. Louis, Mo., has been appointed factory representative covering Missouri, Kansas, western Nebraska, southern Illinois, western Kentucky, western Tennessee and northern Oklahoma.

MARSH *Refrigeration Instruments*



THE Marsh "Serviceman" Refrigeration Service Thermometer eliminates all the guesswork of a pocket thermometer in service work It gives you an accurate, easily read, *remote* reading in the proper way —with a closed door. There is plenty of tubing to reach point of testing, neatly compacted into the case. Guaranteed within one degree—has "Recalibrator" to *keep* it accurate. Use it for servicing all jobs, household and commercial, also in selling refrigerators. Sold in —10° to +65° or —10° to +100° ranges at remarkably low dealers net price of $5.00 (Subject to change without notice.)

JAS. P. MARSH CORPORATION
2059 SOUTHPORT AVENUE, CHICAGO

WRITE FOR NEW CATALOG

A. H. Fine G. R. Postelwait W. A. Siegfried

Mr. Postlewait started in the Engineering Department at the Kerotest plant in Pittsburgh 7 years ago and later became Assistant Purchasing Agent. For the past two years, he has been assistant to Mr. G. C. Taylor, Kerotest Chicago factory representative at 1342 Washington Blvd.

Mr. Willis A. Siegfried has been appointed factory representative covering the Southeastern Territory, with headquarters at 1302 W. Peachtree St., N. W., Atlanta, Ga.

Mr. Siegfried joined the Pittsburgh headquarters sales office about 3 years ago and for the past year has been assisting Mr. K. M. Newcum, Kerotest factory representative in New York City.

Classified Ads

Rate: One Dollar for thirty words or less. 20 cents for each additional ten words or less.

FOR SALE—Brand new refrigerators for outdoor use, built to last a lifetime. Measures inside 7-ft. 8-in. x 7-ft. 8-in. x 7-ft. high. 6-in. thick triple corkboard insulation in asphalt, one horsepower Copeland electric refrigerator unit. Furnished complete. Special low price. General Engineering & Mfg. Co., 1523 So. 10th St., St. Louis, Mo.

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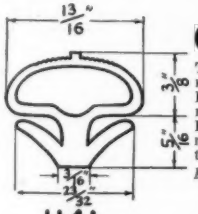
REFRIGERATOR DOOR GASKETS



The gasket illustrated was made especially for 1934 KELVINATOR replacement. IT FITS. All JARROW gaskets are built to manufacturer's specifications.

Insist on Jarrow replacement.

JARROW PRODUCTS CORPORATION
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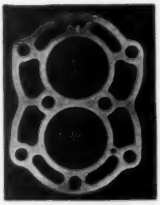

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offer you Metallic Gaskets that hold regardless of what your refrigerant may be and will not shed particles of material to clog up important working parts in a machine. A metal that will not "creep." Once tight it will stay "tight."

Send for catalog

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Another **OUTSTANDING VALUE**

TYPE "B" THERMOSTATIC VALVES

These rugged, dependable valves are constructed of the finest materials available to the industry. A forged body, tough, non-porous and finely machined is only a part of the many new features embodied in these valves. Others include easily removable needles and seats, removable power elements (which have always been gas-charged) easily changed in the field. Adjustable and accurate to a fine degree.

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1481 14th St.

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WEATHERHEAD

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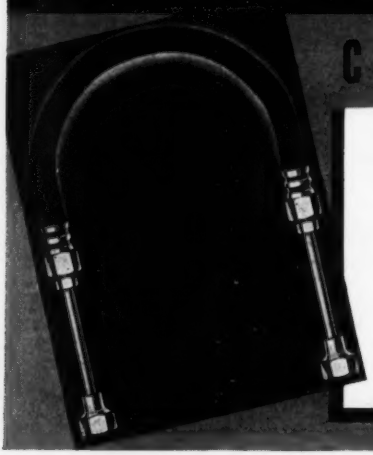

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out of refrigeration and air conditioning work with these IMPERIAL PRODUCTS

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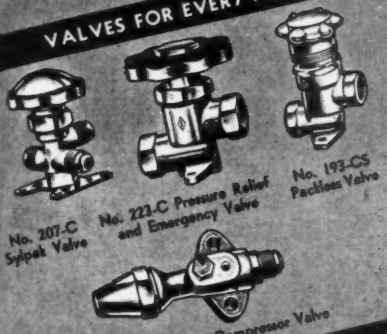
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No. 193-CS Packless Valve
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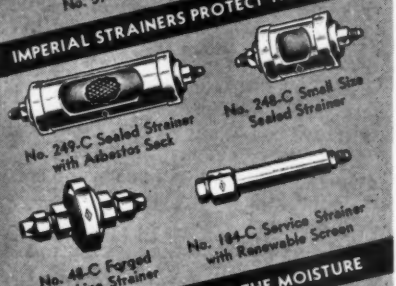
No. 249-C Sealed Strainer with Asbestos Sock
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No. 48-C Forged Brass Line Strainer
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DEHYDRATORS TAKE OUT THE MOISTURE

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C-H

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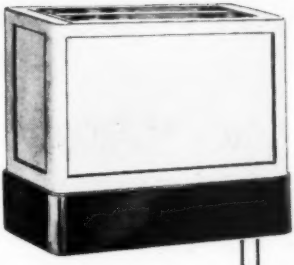

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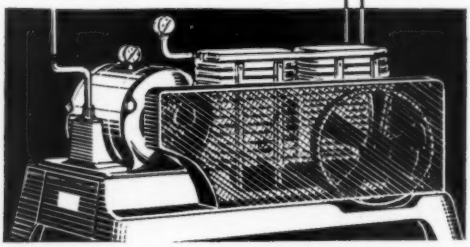

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